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CONTENTS

Co-operation of Industries in Research

THE summer meetings of the Society of Chemical Industry at Cardiff were notable for at least three addresses which dealt with different, but important, aspects of scientific and industrial research. In his presidential address on "Science and Industry : the Fertility of Ideas", without, we imagine, wishing to stress a distinction between 'pure' and 'applied' research which to-day is more and more difficult to draw, Dr. J. T. Dunn emphasised the enormous value to industry of scientific research as such, apart from the research directed to specific industrial purposes.

We shall no doubt witness in the future examples of purely scientific inquiries yielding results to industry and to society fully as valuable as those with which the names of Faraday, Langmuir, Prout and Rayleigh are associated ; but the changed conditions of modern science make it doubtful whether such examples are quite as probable as in the past, at least, so far as the physical sciences are concerned. There the field has already been so thoroughly explored that it is now possible for the specialist to state very exactly where lie problems still to be solved or the directions of advance. What is required, however, is a much more determined and enterprising support of purposeful long-range or fundamental research by industry, both within and without its own immediate bounds.

Dr. Dunn's address was an appeal for wider support of this type of research, and his plea found strong support in two subsequent lectures. In the first of these, Prof. H. Freundlich's discussion of plasticity as the servant of industry showed the manifold bearings of research in this field. Our knowledge of the properties and behaviour of plastics is of fundamental importance to the manufacturer of synthetic resins, cement or concrete, briquettes, paints, varnishes or adhesives, to the ceramic industry, the cellulose industry, the rubber industry, while other industries such as those concerned with the properties of dyes or of dispersions may equally benefit from the knowledge and technique developed in this field. It would, in fact, be difficult to find a more striking example of the way in which many industries may find a common field for research or of the way in which advance in one section may prepare the way for advance elsewhere.

Prof. Freundlich's lecture abounded in suggestions, and indicated how invaluable contact

between different industries might be in solving outstanding problems in this field. It provided an unmistakable plea for more co-operation in research between different industries, for the pooling of knowledge and technique in an attack upon fundamental problems of common interest.

Striking examples of co-operation in this way have already been seen in some of the work of the research associations under the Department of Scientific and Industrial Research, notably that of the Non-Ferrous Metals Research Association and the Refractories Research Association. There are, however, many fields, for example, chemical engineering, in which a great deal more could be done by co-operative effort between two or more industries; and the suggestion implicit in Prof. Freundlich's paper might well be taken up widely by industry. It may contribute materially to the solution of the problem of financing the all-important long-range research.

What is needed is some sense of perspective and a wide vision, and the Messel Memorial Lecture delivered by Sir Harry McGowan was a welcome reminder that these are not lacking in some of our leading industrialists. Under the title "The Uneven Front of Research", Sir Harry, besides directing attention to gaps in our existing structure of research, displayed that imagination and vision which are indispensable if scientific or industrial research is to be carried out on the broad front required. Reference was made once more to the far more vigorous developments in the physical sciences than in the biological, but examples of uneven development are also apparent in other spheres of life where knowledge and practice are still largely empirical and not scientific. Cooking, for example, as Sir Harry McGowan pointed out, remains a traditional art, and the chemistry of cooking, dietetics, the handling and transport of food, offer a field of research which will afford an accurate knowledge of food values and the effects of treating food likely to revolutionise our ordinary household ideas and practice in the next fifty years or so.

In spite of the complexity of the problems presented by agriculture, the fishing industry, the breeding of animals and other biological industries, the amount of research being carried out in these fields is still insignificant compared with that being prosecuted in the comparatively simple sciences of chemistry and physics. Air-conditioning and ventilation still present most fertile fields for research, while the application of the results of investigations in this field has only just begun in industry and scarcely at all in private building.

The building industry, indeed, like the paint and varnish industry, provides an excellent example of an industry in which practice is still largely empirical and traditional, and in which science is only now being applied to provide a rational basis for practice. The possibilities have been enormously expanded in recent years by the provision of new materials such as synthetic resins, new alloys, new lacquers, varnishes or other plastics of improved properties. The utilisation of such material involves frequently a complete break with traditional practice, and only an industry imbued with a scientific outlook and vigorously prosecuting its own research can hope to profit by the new materials and new knowledge.

The housing problem indeed offers many opportunities for science to benefit the community. The adoption of the new building materials and new methods of making light, cheap and sound-proof internal partitions may make revolutionary demands on our ideas of building. It is well within the bounds of possibility for the mere application of present knowledge to provide us with houses meeting a much higher standard in regard to comfort, ventilation, heating, lighting, freedom from noise and pests such as the bed bug and dry rot, at a much lower price and in a shorter time of construction than is possible by present methods.

If these advantages are to be secured, it is probable that some degree of co-ordination or co-operation may be required. This was indeed suggested by Sir Harry McGowan; and both Dr. Dunn and Prof. Freundlich from different points of view indicated the advantages to be gained in this way. Close contact must be maintained with research workers in various branches of science and of industry, if the building industry, for example, is to have at its disposal all the knowledge of the facts required. Air-conditioning is another example of direct interest to almost the whole field of industry, and researches on noise and its prevention have a similar wide bearing. Such investigations might well be planned and directed by one national organisation instead of being carried out piecemeal and ineffectively in different industries with overlapping and waste of effort. Problems of heating are similarly of general interest, while the concern of the building industry in plastics, whether from the point of view of new constructional materials or protective varnishes, etc., is so great that the fundamental investigations required on

the properties of plastics have a fair claim on it among other industries for support.

It is impossible to leave the fundamental research work entirely to the support of individual industries, even those at first sight most closely concerned, if the gaps in our existing organisation are to be filled and research maintained evenly over the wide front now required. Much the same point was made by Sir Harry McGowan in regard to accident prevention when he suggested an Accident Research Department which, besides conducting much more scientific investigations into the causes of accidents, might lead to fundamental improvements in the design of automobiles, etc. Apart from this, at present, inadequate use is being made of the facilities which exist for fundamental research in such matters. For example, the opportunities provided by the William Froude tank at the National Physical Laboratory have been severely restricted by the reluctance of the shipbuilding industry to provide the necessary financial support even on a fifty-fifty basis with the Government offer, and not merely is testing being delayed or carried out on the Continent, but also urgently needed fundamental investigations bearing on design have been similarly hindered.

The matter of co-operation is vitally important where such fundamental work is concerned. The really creative work leading to revolutionary changes in design and outstanding advances, on the necessity for which Sir Harry McGowan laid repeated stress, is much more likely to come as a result of co-operative effort over a wide front than from efforts in one field of science or section of industry alone. It is difficult to over-estimate the stimulating effect of the contact thus received between workers in different industries or different branches of science, above all in days when sectionalism and specialisation present a perpetual menace in science as in society. If the meetings of the Society of Chemical Industry at Cardiff have done nothing else, they have reminded us once more of the imperative need of facing this problem of the lopsided development of research and of the stimulating results which may flow from wisely co-ordinated co-operative research on a wide front. Both the creative thought and the progressive and co-operative outlook required might be attained the more readily did men of science and industrialists alike utilise more widely the opportunities for contact and free discussion which annual meetings and congresses afford.

New Interpretation of Tissue Excitation

L'Excitation électrique des tissus : essai d'interprétation physique. Par Dr. A.-M. Monnier. Pp. xvi+326. (Paris : Hermann et Cie., 1934.) 85 francs.

WHEN an effective stimulus is applied to an irritable tissue, there results a characteristic disturbance which may be propagated to a point more or less distant from the locality of the stimulus. In the central nervous or the autonomic systems, the success of this conduction depends upon factors of a highly complex kind involved in terms such as 'facilitation' and 'inhibition'. The principal phenomena in the physiology of irritable tissues may thus be divided into two groups: those concerned (*a*) with the properties of the stimulus by virtue of which it is effective, (*b*) with the conduction of the propagated disturbance once it has been initiated, including the special phenomena associated with conduction in the central nervous system, etc.

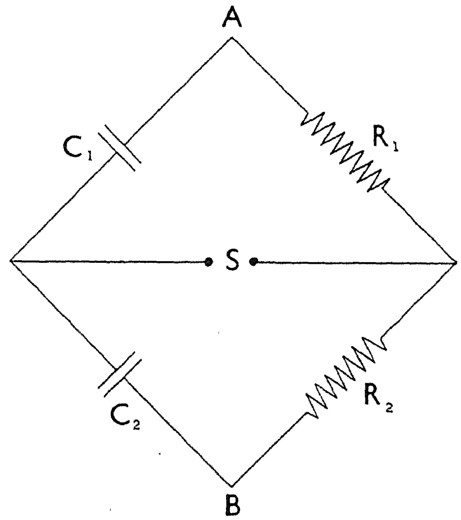

FIG. 1.

Many attempts have in the past been made to treat theoretically isolated phenomena in this field, and though in many cases an excellent correspondence has subsisted between theory and experiment, this has invariably broken down on application to a wider range of observation.

The outstanding advantage of Monnier's treatment described in the work under notice is that it contemplates the whole range of irritable phenomena. To accomplish this without undue complexity, he has sacrificed quantitative treatment and contented himself with the demonstration that his theory will account qualitatively for the greater part of relevant observations.

(*a*) In treating the phenomena of electrical

stimulation, Monnier assumes that tissues react to any kind of stimulus according to the schema shown in Fig. 1. If the stimulus is applied to the terminals S, the excitatory effect is supposed to be given at each moment by the potential difference AB. This potential must attain some fixed value in order to excite.

Monnier assumes that $C_1R_1 = 6C_2R_2$ for all tissues and all circumstances, and shows that there is a good general qualitative correspondence between theory and observation for stimuli of very different time courses. A criticism of this section of the work is that experimental observations are treated in too great detail. When the qualitative applicability of the theory has been shown for one kind of stimulus, it scarcely requires another chapter to show all over again that a slightly modified stimulus still more or less corresponds. This very detail, however, supported by a full bibliography, constitutes a valuable source of reference.

About one third of this section of the book is concerned with stimuli having a time course represented by $e^{-\alpha t} - e^{-\beta t}$. The importance of this form of stimulus appears to be that from the results it is possible to assess accurately the ratio C_1R_1/C_2R_2 of the schema. It is in fact found that the value should be 2 and not 6 as assumed in the earlier part of the book—a change which we are assured is without material consequence, but which naturally affects the unity of the work. But the above form of stimulus is of interest from another point of view, namely, that it resembles very closely the form of the action potential wave. If therefore it is assumed that the propagation of the nervous impulse is due to the successive stimulation of inactive regions of tissue by the advancing action potential wave, the efficacy of conduction will be dependent upon the potency of a stimulus of the above form.

(*b*) The treatment of the phenomena of *conduction* thus arises immediately out of the foregoing, for the stimulating value of a current of the known form of the action potential wave may be found by reference to the schema. From such investigation it appears that conduction is favoured by factors which diminish the rate of development of the wave, relative to the rate of development of the excitatory process in the adjacent tissue (that is, its chronaxie), and conduction is impaired by the converse effect. Upon this deduction is based the rest of the book. This attempts the ambitious task of placing upon a more or less physical basis the remarkable claims that have been made by Lapicque's school, that the supreme condition permitting conduction from one cell to the next is equality of their rates of excitation (= chronaxie).

Monnier assumes that normally the action potential wave is not greatly above the threshold for stimulation of the next cell, so that if a drug (or other factor) retards the process in this second cell, and hence reduces further the efficacy of the stimulus, conduction will fail altogether. But naturally the author has to find a different explanation for the action of veratrine, which paralyses while accelerating the second cell, and for that of strychnine, which paralyses while slowing the action potential of the first cell.

The weakest part of the theory appears to lie in the assumption that the action potential wave is so nearly ineffective in the normal state that, if the threshold of the second cell is increased by only 20 per cent, conduction will fail. This assumption, which is fundamental, is difficult to accept in the light of the fact that two impulses may successfully follow each other in quick succession, though the threshold for the second appears to be raised some hundreds per cent.

A particularly satisfying feature of Monnier's analysis is that he is clearly aware of its shortcomings. He is careful to point out those places where the theory is too simplified to give more than an indication of the mechanism under consideration, and he directs attention to observations which are not accounted for by his theory, as well as to those supporting it. Finally, he has added a chapter to show the way in which the theory may be developed to explain phenomena in a more quantitative manner.

Monnier's book is intended primarily for the experimental physiologist, and to that end mathematical complexity is avoided. The solutions of the various equations are represented graphically as oscillograph records taken from actual experiments with a model of the above schema. Thus those interested in the excitation theory will find in the book an excellent compilation of experimental data, a balanced critical analysis and a well-defined embracing concept of wider application than any hitherto advanced.

North American Timbers

Identification of the Timbers of Temperate North America: including Anatomy and certain Physical Properties of Wood. By Prof. Samuel J. Record. Pp. ix+196+7 plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 18*s.* 6*d.* net.

PROF. RECORD by this book has forged another strong link in the chain which helps to bind the scientific worker to the intelligent wood enthusiast, whether a practical wood worker or interested in other directions. The book is

divided into two parts, and with plates and indexes occupies some 213 pages. The first part is styled "The Anatomy of Wood and certain Physical Properties of Wood"; and the second part "Timbers of Temperate North America", to which is attached a descriptive key.

Just as the surgeon requires accurate knowledge of the particular organ upon which he is to operate, so should the wood worker in like manner familiarise himself with the constitution and anatomy of wood. Hitherto this study has been far too much neglected, and a wide gap has existed between the scientific worker and workers in the practical field. Prof. Record's work bridges this gap. The student, who for the first time is opening his eyes to the marvellous wonders of tree growth, the ardent enthusiast who has progressed a long way on the road, and the wood scientist, all alike will gain knowledge from Record's conscientious work. Those pages in the first part, with illustrations of wood structure, relating to texture, grain, figure, colour, lustre, scent, taste, density and specific gravity, will probably capture the greater number of readers, although the second part, "The Timbers of Temperate North America", with the descriptive key, would appear to have been considered by the author as the more important, as he explains that the book is produced to replace an earlier edition now out of print.

Prof. Record says: "Woods deriving their odors from the presence of ethereal oils, as in many Cedars, apparently may be kept indefinitely and still emit their characteristic odors when a fresh surface is exposed." Evidence could be produced which conclusively shows that certain woods emit their scent after a lapse of certainly more than two hundred and fifty years, and probably twice that time, even without any fresh exposure of the surface.

In a book which teems with information it is difficult, if not impossible, to select those pages to which reference should be made in a short review, but the value of the work consists in the clear, concise information, supplemented by admirable plates, especially those descriptive of figure and the transverse section of grain shown of no less than twenty-seven of the best-known American timbers, as well as photomicrographs of vertical, radial and traumatic cells, and similarly well-produced plates of rays and cells with descriptive explanation, all of which invite a close and concentrated study from even those who have only a very modest knowledge of the subject.

As with other studies, the master here will find that his book attracts many new disciples to the world of knowledge of tree growth and structure.

ALEXANDER L. HOWARD.

Metallurgy and Foundry Practice

(1) *Practical Microscopical Metallography.* By Dr. R. H. Greaves and H. Wrighton. Second edition, revised and enlarged. Pp. xi+256+54 plates. (London: Chapman and Hall, Ltd., 1933.) 18*s.* net.

(2) *The Alloys of Iron and Molybdenum.* By J. L. Gregg. (Published for the Engineering Foundation.) Pp. xii+507. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 36*s.* net.

(3) *Special Steels: a Concise Treatise on the Constitution, Manufacture, Working, Heat Treatment and Applications of Alloy Steels; for Students, Operators and Users of Special Steels; chiefly founded on the Researches regarding Alloy Steels of Sir Robert Hadfield.* By T. H. Burnham. (The Specialists' Series.) Second edition. Pp. xviii+234. (London: Sir Isaac Pitman and Sons, Ltd., 1933.) 12*s.* 6*d.* net.

(4) *Elementary Metallurgy for Engineers.* By G. F. C. Gordon. Pp. ix+156+12 plates. (London: Constable and Co., Ltd., 1932.) 8*s.* 6*d.* net.

(5) *Foundrywork and Metallurgy: a Practical and Authoritative Guide for Moulders, Pattern Makers and Apprentices.* Edited by R. T. Rolfe. Vol. 1. Pp. vii+256. Vol. 2. Pp. viii+257–504. Vol. 3. Pp. viii+505–760. Vol. 4. Pp. viii+761–992. Vol. 5. Pp. viii+993–1216. Vol. 6. Pp. viii+1217–1464. (London: Sir Isaac Pitman and Sons, Ltd., 1931–1932.) 6*s.* net each volume.

(1) MESSRS. GREAVES and Wrighton's handbook of microscopical metallography has now reached a second edition, and has been considerably enlarged and improved. The descriptions of technique are full and practical, being based on a wide experience of both hard and soft metals, and the laboratory worker will usually find them a safe guide. The authors employ an ordinary table pattern of microscope, and more might have been said on the subject of microscope design, as many readers will be called upon to use the inverted type, especially in the compact form now so widely adopted in industrial laboratories. Macro-etching, sulphur printing and similar processes are well described, and the excellent photomicrographs, some 270 in number, will be found valuable for reference.

The theoretical aspects of metallography are only discussed so far as is necessary to indicate the meaning of structures as they present themselves in each system, but the equilibrium diagrams of the most important alloy systems are

included. Some familiarity on the part of the reader with the construction and interpretation of such diagrams is therefore desirable.

(2) The Battelle Institute of Columbus, Ohio, is rendering a great service to metallurgy by the publication of a series of exhaustive monographs of the alloys of iron, based on a critical survey of the whole available literature. The volume under notice, the third of the series to appear, deals with the alloys of molybdenum. Steels containing molybdenum have become increasingly important in recent years, but the data concerning them are scattered through many technical journals and trade publications. After eliminating second-hand accounts, 800 papers had to be abstracted for the purposes of this volume.

The simple alloys of iron and molybdenum are mainly of interest from the remarkable degree of precipitation-hardening which some of them can undergo, making them suitable for use as dies for drawing hard metals. When added to nickel chromium steels, molybdenum has the property of preventing the temper-brittleness to which such steels are liable, and this combination has proved particularly useful in engineering practice. Resistance to creep at high temperatures, and suitability to nitriding are other purposes for which the metal is added to steels. More recently, molybdenum cast irons have found application. The compilation has been well done, and there is a full and valuable bibliography.

(3) Mr. Burnham's book on special steels, mainly based on the work of Sir Robert Hadfield, has been enlarged on passing into a second edition. It contains an interesting account of the methods employed in making special steels, which often differ widely from those usual in works where structural steel is made. It is in this field that the high-frequency induction furnace, for example, finds its application.

The book contains much useful information, marred in some cases by the use of trade names in place of compositions. The author's references to literature, especially to foreign publications, are sparse and rather arbitrarily selected, but the book will be found most useful by the metallurgist familiar with common steels, who is imperfectly acquainted with these newer and more specialised developments.

(4) To present the main facts of metallurgy in such a way as to be intelligible to engineers is not an easy task, but it has been essayed by many writers. Mr. Gordon's book is elementary and clear in its presentation, but it suffers from a lack of first-hand knowledge, so that the descriptions of technical processes contain many minor errors, although the main outlines are satisfactory. The treatment of constitution and structure is weak. The long-discarded β-allotropic form of iron is re-introduced, and even employed to explain blue-brittleness, whilst the term "Ac_3" is introduced on p. 64 without explanation, and its meaning is only to be inferred from a diagram forty pages later. A reader having no previous knowledge of metallurgy will find this book useful as an introduction, but the ideal metallurgy for engineers remains to be written.

(5) This handbook for the foundryman, edited by Mr. Rolfe, makes its appearance in six handy and very well printed and illustrated volumes. It is actually the work of a number of authors, and covers, section by section, the subject of foundry practice and such matters as pyrometry and metallography so far as they are of direct value to the foundryman. The authors are all experts in their own branches, and tests applied at random have shown the descriptions to be up-to-date and correct. Such subjects as die-casting and centrifugal casting, information on which has usually to be sought in journals, are well treated, and the volumes will no doubt be frequently consulted in those foundries—fortunately an increasing number—where attention is paid to the scientific control of the making of castings.

Lorentz's Collected Papers

Collected Papers. By H. A. Lorentz. Vol. 7. Pp. vii+399. (The Hague: Martinus Nijhoff, 1934.) 10 guilders.

THIS volume is the first to be produced of the projected nine volumes of the collected papers of the late Prof. H. A. Lorentz. It contains a number of papers—nineteen in all, mainly printed addresses—otherwise accessible only in rather scattered places. The period covered is 1897–1927 and the subjects are spread over practically the whole wide range of the author's interests. There are lectures on hydrodynamics; on the Zeeman and other magneto-optical effects; on the rotation of the earth and its influence on optical phenomena; on the old and new mechanics; and on the partition of energy in radiation and the quantum theory.

The subjects dealt with show the broad interests of Lorentz, and the individual lectures themselves are typical examples of his characteristic genius, of his penetrating spirit in comprehending the physical essence of any new theory, and of his masterly power of exposition in writing of such theories. They are also typical in one other aspect, namely, in showing the part played by their author during his long life in the development and redevelopment of modern physical theory. At certain stages in the development of both the

theory of relativity and the theory of quanta, it seemed as though the classical theory of electricity, which owed so much in its early stages to Lorentz himself, would have to be thrown overboard completely, in consequence of the rapidly increasing difficulty in fitting it to the accumulating mass of experimental detail. Again and again, however, the influence of the master, who knew his classical theory better than the younger generation, and could therefore see how far and in what direction the inconsistencies lay, predominated and, in a new and generalised form perhaps, this theory now takes an honoured and essential part in the current explanation of physical phenomena. This moderating spirit is particularly predominant in a number of the critical lectures in the volume before us.

Lorentz rarely encumbered his work with the unnecessary hypothesis so frequently introduced in order to work out special cases in numerical detail, so that his discussions have always remained pertinent and readable longer than those of most writers; and in spite of the editor's description of the lectures in this volume as non-elementary, one would like, on this account alone, to commend them heartily to all students of mathematical physics who are not averse to reviewing in some detail the still close connexion between the complex physical theories of to-day and the rather less complex ones prevailing a quarter of a century ago.

The style and letterpress of the book are both very pleasing, and the editors and publishers are to be congratulated on the way in which it is produced. When complete, the nine volumes will certainly form a fitting monument to the memory of the great physicist whose name they bear.

G. H. L.

Short Reviews

Plant Chimaeras and Graft Hybrids. By Prof. W. Neilson Jones. (Methuen's Monographs on Biological Subjects.) Pp. viii+136. (London: Methuen and Co., Ltd., 1934.) 3*s.* 6*d.* net.

THIS excellent concise account of those peculiar combinations of plant tissues, belonging to two different varieties, species, or even genera, which are known as chimæras, will be welcomed by both students and teachers. A clear and useful distinction is drawn between chimæras and graft-hybrids, the latter term being retained for plants which (supposedly) arose from nuclear fusions between scion and stock. This conception is precise and there is nothing in it that is impossible on theoretical grounds. The author, however, is very distinctly in favour of the chimæral hypothesis for all those examples which have been relatively well investigated. This hypothesis was put forward by Baur as a result of his studies of *Pelargonium* varieties, though the name 'chimæra' was used by Winkler for a branch built up of two genetically distinct tissues. The 'chimæral hypothesis' assumes that the pattern found in the mature organ of a chimæric structure "is merely a development of the pattern already present at the growing point".

Prof. Neilson Jones discusses the well-known examples of chimæras in *Pelargonium, Solanum, Cytisus* (*Laburnum*), *Crataego-Mespilus* and *Hydrangea*, besides less-known instances. For the latter, some original interpretations are made, and these tend to bring the examples, in general, into line with Baur's hypothesis. A useful introduction presents some of the relevant facts connected with grafting and a general summary condenses the more important results derived from the study of chimæras and possible graft-hybrids into three and a half pages of print. Twenty-one figures illustrate the text and are mostly outline diagrams useful for blackboard reproduction. A bibliography and index are provided.

W. B. TURRILL.

Memoirs in Miniature: a Volume of Random Reminiscences. By Dr. G. C. Williamson. Pp. 273. (London: Grayson and Grayson, Ltd., 1933.) 10*s.* 6*d.* net.

MANY books have been described in their titles as containing the 'gems' and 'cameos' of their subject, but no author has greater claim to the description 'in miniature' than Dr. G. C. Williamson, who is known all the world over for his lifelong and intimate acquaintance with many forms of art, among which portrait miniatures take a high place. He tells us how his pursuits, partly undertaken for Mr. Pierpont Morgan, have taken him into good and high company: we now thank him for sharing his introductions to that exalted circle. But "the old slides which he has put into the magic lantern of his life" also cast welcome sidelights on Victorian science, and it could scarcely be otherwise, for he comes of a scientific stock. His father was an analytical chemist who won the approval of Faraday by the discovery of a new method of fractionating coal-tar. His grandfather, J. O. N. Rutter, is remembered for his success in the practical application of electricity when the names of his intimate friends, Faraday and Brunel, were less well-known than they are to-day. Wheatstone's first electrical signalling apparatus was used in his library at Brighton; and his work on "Human Electricity" is a classic. Another memoir recalls that wonderfully fascinating centre, the Regent Street Polytechnic, where the diving bell, Pepper's ghost, the great plate electric machine, the zoetrope, glass-spinning, etc., were in daily operation, giving to thousands of the youthful visitors of the 'seventies a vivid and enduring impression of the powers and marvels of science.

But Dr. Williamson's reminiscences teem with interest: one never knows what or whom one will meet next. Many deserve a larger canvas.

The Preservation of Antiquities. By Dr. H. J. Plenderleith. Pp. viii + 71 + 2 plates. (London: The Museums Association, 1934.) To members, 2*s.*; to non-members, 2*s.* 6*d.*

THIS little volume is from the authoritative pen of the Assistant Keeper in the British Museum Laboratory. It is, in the first instance, a laboratory manual, containing concise instructions for the cleaning and preservation of a wide range of objects of antiquarian interest—leather and textiles; wood, bone and ivory; siliceous materials such as earthenware, glazes and enamels; and metals, notably copper, bronze and lead. The section on corrosion of metals is particularly fresh and illuminating and, above all, practical.

The book is, however, more than a mere technician's guide. It is easy, reading between the lines, to visualise the blend of scientific acumen, imagination, patience and keen artistic appreciation, which have gone to the formulating of the methods described, all of which are employed in the British Museum Laboratory. The antiquarian and the man of science are, in general, lacking in knowledge of that wide but little-known field where their common interests overlap. Here is a book which will interest both, and also their friend the layman: for though the antiquarian will doubtless be ignorant of the exact rôle played by moist common salt in metallic corrosion and the 'bronze disease', it will probably surprise the scientific worker to hear of the jealous care with which a healthy bronze patina is cherished, and the æsthetic value attaching thereto. The layman also may be less inclined to take for granted the bloom on the majority of our more ancient museum exhibits.

Dr. Plenderleith's book sets a high standard for the companion volumes which will follow it, "dealing with subjects of interest to the museum curator".

P. D. R.

Birth Control To-day: a Practical Handbook for those who want to be their Own Masters in this Vital Matter. By Dr. Marie Stopes. Pp. iv + 237 + 4 plates. (London: John Bale, Sons and Danielsson, Ltd., 1934.) 5*s.* net.

THIS is a practical handbook dealing with methods of birth control, written in simple language so that it can be understood by the ordinary man and woman. Dr. Marie Stopes, for the same reason, writes somewhat dogmatically and gives practical advice based upon a unique experience. After a simple description of the sex-organs and the physiology of reproduction, so as to make clear what it is that has to be controlled, the methods by which pregnancy may be prevented are fully described. These range from domestic makeshift methods to obstructive appliances and chemical spermaticides, the surest of all, according to Dr. Stopes, being an occlusive rubber cap together with a simple grease suppository.

Various questions bearing upon birth control are asked and answered, and a chapter is devoted to birth control clinics. 'Positive' birth control is also referred to—when children are desired, but have failed to materialise. The subject of birth control is of such national, as well as individual, importance that a knowledge of what it aims at, and how it may be effected, should be accessible to all who desire it, and we believe that this book provides that knowledge and deserves to be widely read.

Chemische Unterrichtsversuche: Ausgewählte Beispiele für den Gebrauch an Hochschulen und Höheren Lehranstalten. Von Prof. Dr. H. Rheinboldt. Pp. xx + 326. (Dresden und Leipzig: Theodor Steinkopff, 1934.) 10 gold marks.

PROF. RHEINBOLDT'S manual differs from the standard works on lecture experiments in several ways. It includes some experiments on organic chemistry and gives copious references to the literature of ordinary descriptive chemistry. A liking for unusual methods and complicated apparatus is also often apparent. It is difficult to say what purpose is served in a manual for the preparation room by the references which fill up much space, and the deviations from standard practice are sometimes almost grotesque. The usual method of sparking ammonia over mercury in order to show its decomposition is historically sound, since it is the method originally used; the experiment given uses a peculiar eudiometer and confines the gas over di-*n*-butyl phthalate coloured with Celliton Red R I.G.Farbenindustrie A.G. Instead of inverting a jar of hydrogen sulphide over one of sulphur dioxide, the author uses a quite unnecessarily complicated apparatus. Many striking experiments, such as the reaction between chlorine and hydrogen iodide, do not seem to be mentioned.

Although the book has many good points, it does not seem as though it is likely to become popular in England, since it does not appear to fit in with the usual lecture courses in universities, and makes use of apparatus and materials not commonly available in school laboratories.

The Hour of Decision. Part 1: *Germany and World-Historical Evolution.* By Oswald Spengler. Translated from the German for the first time by Charles Francis Atkinson. Pp. xvi + 230 + xiii. (London: George Allen and Unwin, Ltd., 1934.) 8*s.* 6*d.* net.

THE author of the "Decline of the West" has now found the solution of the world's ills. The economic crisis, unemployment and the political difficulties of the day could be eliminated by the application of cold-blooded "Prussianism", without which the world would indeed be overwhelmed by an uprising of the coloured races. Why "Prussianism"? Because "Germans are still young enough to experience world-historical problems, to form them and solve them; inwardly, while other nations have become too old and rigid to do more than raise defences". Many readers will undoubtedly resent this extraordinary thesis of Spengler's, and point out that the collection of historical facts piled up by him has not necessarily the unilateral interpretation he gives them. But however unconvincing these views, they need careful consideration, especially at a time when some kind of 'intellectual' defence of Hitlerism is becoming fashionable among German thinkers.

T. G.

Psychology and Social Problems*

By DR. SHEPHERD DAWSON

SOCIAL problems are partly material and partly mental. Every society consists of interdependent personalities whose harmonious co-operation is necessary for the general well-being, and the really serious problems of life concern this co-operation. Very great progress has been made in the solution of the material problems; but much less attention has been given to the study of the mental aspects of social welfare. Nevertheless, for a proper understanding of the numerous problems that arise from life in a community, such as those of supply and demand, labour and capital, law and order, hygiene, housing, transport, education, the conflict of traditions and ideals, and local and international rivalries, the study of mind is just as important as is that of matter. The solutions to these problems are to be found ultimately in the forces that move men to action, in their inherited tendencies, in their acquired habits, in the mentality of the groups to which they belong, and in their relationships to those groups.

Social problems can be approached either from the point of view of the individual or from that of the group to which he belongs. Neither approach can be consistently maintained to the exclusion of the other, for the problems of the individual are the problems of society and vice versa: a man is not independent of his fellows; his social environment is part of himself; his thoughts, feelings and desires vary with his environment; he is socially a chameleon, and any account of him which fails to consider his environment is as distorted as is an account of society itself which fails to consider the variety of aptitudes, motives, knowledge, manners and customs of its members. A social group is a complex structure which contains within itself other groups and sub-groups, professional, economic, linguistic, etc., whose harmonious co-operation is necessary for the welfare of the whole. The big social problem is the dual one of fitting the individual into the group and fitting the group to the individual. This is essentially an educational problem, one for education in the widest sense of the word; it concerns the home, the school, the university, the Press, and broadcasting and other publicity agencies. Its solution demands some knowledge of the natural endowment of the individual, his impulses and intellectual capacities, and of methods of making the most of them; and this in its turn implies the need for, and the use of, methods of assessing human endowment and achievement.

* From the presidential address before Section J (Psychology) of the British Association, delivered at Aberdeen on September 7.

I wish to consider especially the scientific assessment of natural capacity and some of the problems connected with it; therefore, it is necessary to keep clearly in mind the distinction between ability and capacity. Ability is actual, capacity is potential. Ability is measured by what can be done here and now; capacity can usually be estimated by what can be done after a course of training. Knowledge and skill at games are forms of ability; they depend on certain natural capacities and on upbringing. All examinations are tests of ability.

The measurement of ability is difficult enough, but the estimation of the parts played by native capacity and upbringing respectively in determining such ability is very much more so. Innate qualities do not exist *in vacuo*: they exist with reference to certain external conditions and they must be diagnosed and measured in relation to these conditions. Every test is directly a test of ability, and can be a test of capacity only indirectly. Where training has no effect on the expression of a capacity, then a test of ability is a test of capacity; but few, if any, capacities are unaffected by training. If opportunities and incentives are so widely scattered that they are available for everybody, or if similar training has been given to all, then differences in performance indicate differences in capacity; but where the essential training and environmental conditions vary, inferences regarding capacity can be made with much less certainty. It is difficult to convince oneself regarding the uniformity of external conditions: for example, it is sometimes supposed that mental differences between children of the same parents are due solely to genetic differences, but some of them are certainly due to variations in the family environment: the health and age of the mother are not the same at the birth of each child (unless they be twins); families move from easy to difficult circumstances and vice versa; parents become more experienced, or more indulgent, in the management of their children; school-fellows vary; and the children themselves vary in their relationships to one another and to the rest of the world. The conditions of the experimental chemical laboratory cannot be exactly reproduced in the study of human and social phenomena; we have to be content with approximations to these conditions.

It is necessary to stress these considerations of method, for psychologists have hitherto been more concerned to distinguish and measure different kinds of ability which *seem* to be dependent on

native capacity than to prove their innate basis. An example may make this clear. It is a common belief that people differ in respect of mechanical ability, that some have little difficulty in understanding the working of a motor-car, a dynamo, a clock or other piece of mechanism, and that others find these things unintelligible; it is also commonly believed that these differences are due to differences in natural capacity. Now, the first thing that must be done is to find whether there is actually a positive correlation between ability to solve one kind of mechanical problem and ability to solve other kinds, for until such a correlation has been established, it is futile to talk about mechanical ability. This is the kind of problem on which much effort has been spent, especially in Great Britain: but after a correlation has been established, it is still necessary to find to what extent this ability is the expression of a specific inborn capacity. This more difficult problem is usually attacked by using test situations so novel that there is little probability of one examinee having any advantage over another through familiarity with the situation, or by using problems such as occur so often that it can be presumed that inability to solve them is due ultimately to innate incapacity. In practice, the difficulty, once it has been recognised, is probably not so great as may appear, for the opportunities of, and the need for, exercising most of one's native capacities are in fact numerous; a person who fails to pass a properly designed and properly conducted test of colour-blindness is almost certainly colour-blind.

All kinds of capacities are being investigated with varying success, and it may be possible some day to evaluate mental characters with some approximation to the accuracy with which physical characters can be assessed. Most progress has been made in the evaluation of intellect by the so-called intelligence tests, largely under the pressure of educational needs.

Repeated application of mental tests to the same children suggests that mental development, as measured by the tests, proceeds along lines analogous to those of physical development and that it reaches its maturity about the age of adolescence, as do stature and other physical characters. The *rate* of development is expressed by the ratio of the level reached by the individual to that reached by the average of his age—for example, a boy of age ten years who has reached only the level of the average nine-year-old is said to have an intelligence ratio (mental ratio or intelligence quotient) of nine tenths or 90 per cent. This figure seems to measure some innate capacity or capacities, for, though it varies from one person to another, yet it remains fairly constant for each individual, and appears to be little affected by external circumstances. Even serious and long-continued spells of illness appear to affect it very little: it is only ailments producing progressive deterioration of the central nervous system, especially of the brain, such as encephalitis lethargica and some forms of epilepsy, that reduce it. Absence from school may interfere with a child's education and so promote social inefficiency without affecting his intelligence ratio.

Changes in social and physical environment have very little effect in modifying this ratio unless they be very great. Residence in an institution does not appear to make the ratios more alike than they were on admission, and children who have never seen their parents, but have been reared in the same homes, show the same differences of intellect as do their parents. It is very hard to find the necessary data to decide this question of the effect of environment. In Glasgow about 300 children were tested at the time of their removal from slum houses to a rehousing area, and again about eighteen months later. It had been intended to allow an interval of two or three years to elapse between the examinations, but so many of the children—about 20 per cent—left their new homes, that the interval had to be shortened. The ages of the children varied from five to nine years, an age at which they might be expected to react quickly to the new and improved environment. At the second test they did on the whole show a just appreciable improvement—their average ratio was raised from 90·6 to 92·1. A control group that did not move from their slum homes showed no such improvement. The result of this investigation is cheering for those who are trying to improve the external amenities of life: but the improvement is so small that it suggests that any improvement in the social virtues that is to attend the initiation of social welfare schemes may have to rely on the formation of new habits of thought, feeling and action, habits that will have to be learned, rather than on any improvement in intelligence.

Here, in the interest of scientific accuracy, a word of caution is necessary. While the constancy of the intelligence ratio raises a presumption that this ratio is determined by genetic constitution, it may, however, to some extent be partly determined by other conditions, ante-natal, natal or post-natal: birth accidents are certainly responsible for some cases of dullness and defect. There are, however, several considerations which suggest that in most cases the ratio does measure something that is innate.

As might have been expected, the average intelligence of the children of men engaged in professional and skilled occupations is higher than

that of the children of unskilled workers; but more interesting and more significant for social problems is the fact that the variability within the different occupations is so great that there is much overlapping; in other words, high-grade intellect is not the exclusive property of any social class or professional grade.

Perhaps more important still is the information regarding the distribution of intellect through the whole population. An investigation was conducted in June 1932 by the Scottish Council for Research in Education with the assistance of education officers, teachers and others, in which a group test was given to practically the whole of the school population in Scotland born in the year 1921 and so of age $10\frac{1}{2}$–$11\frac{1}{2}$ years, 87,498 in all. The result agreed with previous estimates, but the dispersion proved to be greater than had previously been supposed—in other words, there were more who were dull and more who were bright. About half the population examined had mental ratios between 89 and 111 (instead of between 91 and 109, as was previously supposed), and it was estimated that, in the whole population, between $1\frac{1}{2}$ and 3 per cent fell below the 70 line, that is, below the line which is commonly supposed to mark the boundary between mental defect and normality. The average of the boys was the same as that of the girls, but their dispersion was greater, that is, there were amongst them more who were very bright and more who were dull. This distribution has important implications, of which I shall consider only one, and that very briefly—namely, its bearing on the rate at which boys and girls leave school after completing the work of the primary school.

In Scotland about 44 per cent of the children of age twelve embark on a secondary school course; of these 70 per cent begin the second year work, 43 per cent the third, 22 per cent the fourth, 15 per cent the fifth, and 9 per cent the sixth. Of those who pass to the 'Advanced Divisions' only 14 per cent enter on a third-year course. These educational casualties are due to many causes; some fall out for economic reasons, others find—or think they find—a better preparation for the serious business of life elsewhere (and these include some of the brightest), but probably most drop out because school seems to be a testing-ground rather than a training-ground, a means of picking out the brightest. This suggestion finds some support in the fact that it is the duller pupils who drop out first, the very pupils who are most in need of training. It has been estimated that a boy or girl must have an intelligence ratio of 115 or above to profit without undue strain from a secondary school education; this may be an over-estimate, but there can be little doubt that the average secondary school curriculum is unsuitable for the boys and girls whose ratios fall below the mean, that is, for half the school population. The bulk of the population are of average or nearly average intelligence—about 68 per cent have mental ratios between 84 and 116—and it seems reasonable to ask whether a national system of post-primary education should not give first consideration to these rather than to the 16 per cent at the upper end of the scale who have the intellect and temperament that fit them for professional and administrative work.

It may be suggested that the mental development of the duller elements of the population ceases at the age of twelve or thirteen and that, therefore, they have learned all they can learn by that age, whereas the mental development of their more brilliant fellows continues for several years longer. This suggestion is probably incorrect. We know that intellect develops more slowly in the dull, so that they fall farther and farther behind, but there is some ground for thinking that it reaches its maturity at about the same age. Further, the suggestion that the dull child has learned all he can learn by the age of twelve or thirteen implies a certain confusion of thought. Whatever may be the age at which maturity of intellect is reached, and whatever may be the level of development reached, it is certain that learning does not cease at that age: it can continue until senile decay sets in. The age at which maturity is reached has little or nothing to do with the age at which training must cease.

The 'open school door' is a well-established tradition in Scotland: here the gifted child has ample opportunities of developing his talents; but the practice of pushing all children along the same scholastic course, studded with hurdles which must be jumped, under penalty of being left behind, is one which could be improved upon. As the intelligence ratio seems largely to determine scholastic success, and as it remains approximately constant, at any rate during school life, and can be determined early, it should be possible to organise education on a basis of natural capacity.

The study of mental inheritance has suffered sadly from a readiness to take over the crude concepts of everyday life: it has been concerned mainly with marked abnormalities—mental defect and insanity—and this, too, has hampered the study of the subject, for there is widespread opinion that these deficiencies and ailments are morally reprehensible—an opinion which is rarely expressed openly, but is enshrined in everyday speech and conduct.

One serious difficulty in the study of mental inheritance has been that of defining and measuring

accurately the characters under investigation: for example, mental defect can be, and is, defined in several ways, legally, clinically, psychologically, etc. In the legal sense it is a social concept, for according to the law the feeble-minded are "persons in whose case there exists from birth or from an early age mental defectiveness so pronounced that they require care, supervision, and control for their own protection or for the protection of others; or, in the case of children, that they, by reason of such defectiveness, appear to be permanently incapable of receiving proper benefit from the instruction in ordinary schools". However satisfactory this may be as a legal definition, it is useless both biologically and psychologically, for in the absence of any definition of mental defectiveness or arrested mental development, it means just inability to look after oneself and one's affairs without proper supervision. If social environment becomes more complex and makes higher and higher demands on natural capacity, then, unless that capacity improves, the proportion of feeble-minded must increase. Some think that feeble-mindedness *is* increasing, and that this is due to differential birth-rate, but it is equally possible that the cause lies in the increasing complexity of civilised life: intellects that could live happily in a simpler environment may be finding the complexities of modern civilisation too much for them: there can be little doubt that to-day bigger demands are being made on children in the 'ordinary schools' than were made on them fifty years ago.

The clinical varieties of mental deficiency which medical men meet—mongolism, cretinism, microcephaly, hydrocephaly, etc.—are distinguished by anatomical rather than by either social or psychological characters. Psychologically, mental deficiency is usually defined in relation to performance at intelligence tests: the legal mental defective usually has an intelligence ratio below seventy, so this figure is often taken as marking the line that separates the mental defective from the normal. This is an arbitrary method of defining mental deficiency; it has the merit of precision, but it is a precision which may be misleading when we begin to investigate its genetic basis, for it is possible that feeble-mindedness may be due to one or more of a large number of genetic factors; there may be different forms of feeble-mindedness which are not distinguishable by means of intelligence ratios.

From Log Cabin to Royal Observatory

By Prof. Allan Ferguson

The British Association has seen many excursions and occasions, but few can compare, in real romantic interest, with the excursion which set out from the Marischal College in Aberdeen on Monday, September 10, to attend the unveiling of the Lamont memorial above Braemar. Most of us had a vague notion, based mainly on the 'A' appearing on our excursion ticket, that Lamont had some connexion with physical science, possibly with astronomy. A few said, "Why Braemar? Wasn't Lamont a German?"; and, did one seek information concerning Lamont's life and labours from an eminent astronomer, invariably he

> "Dallied with his golden chain,
> And, smiling, put the question by."

The setting was perfect. The road through Braemar climbs along a precipitous hillside and looks down on the Dee falling ever farther and farther below. Four or five miles past the spot where, as tradition tells, the Standard on the Braes o' Mar was up and streaming rarely on a September day in 1715, is the clachan of Corriemulzie where Lamont was born on December 13, 1805, and a couple of miles farther on is the village of Inverey where he had his schooling. Here, on a natural platform a few yards above the road, stands a severe obelisk of grey granite bearing, below a cross of St. Andrew carved on its face, the inscription

This Stone
Commemorates
John Lamont
1805–1879
who was born at
Corriemulzie.
His name is written
in the history of science
as
Johann von Lamont
Astronomer Royal of Bavaria.

On the back of the stone, below a representation of the constellation of Orion, is the text, "Day unto day uttereth speech, and night unto night showeth knowledge", which text is repeated on the west and on the east sides in Gaelic and in German.

The memorial was as yet hidden under a canvas covering, and at four o'clock Prince and Princess Arthur of Connaught arrived and were escorted to the memorial, the pipes playing the Lamont march. The president of the British Association,

Sir James Jeans, explained the occasion in a few fitting words, Princess Arthur unveiled the memorial, and words of thanks concluded the simple ceremony.

What is the link that binds the story of the village lad of Corriemulzie to that of the Bavarian astronomer of world-wide reputation ? This, that at Ratisbon in Bavaria existed a college of Scottish Benedictine monks which from time to time took charge of youngsters from Scotland in order to educate them for the priesthood. John Lamont was so chosen, and on an October morning of 1817 we may picture the twelve-year-old wood forester's son setting out in a farm cart for what was then a toilsome three days' journey to Aberdeen—a road which our motor coaches covered in less than three hours. Arrived at Aberdeen, the travellers set sail for Rotterdam, and thence made their way up the Rhine to their destination. Followed eleven years of hard study, and at the end of that period Lamont, who had discovered a capacity for mathematics, decided that astronomy rather than the priesthood was his vocation. Accordingly, in March 1828 he was appointed assistant astronomer in the Royal Observatory at Bogenhausen, near Munich, of which observatory at that time Prof. Soldner was conservator. In 1835, two years after the death of Soldner, Lamont succeeded to the position of conservator, and in 1852, the year of his election as a foreign member of the Royal Society, he was appointed to the chair of astronomy at Munich*. On August 6, 1879, he died at Munich at seventy-four years of age. The John Lamont of Braemar merged his identity very completely in that of Johann von Lamont, the Bavarian astronomer; indeed, the late Earl of Crawford, who consulted Lamont in 1873 concerning the equipment of an expedition to observe the transit of Venus, furbished up his German for the interview, and was not a little surprised to find his introductory speech answered in good Aberdeen Scots.

What were Lamont's principal contributions to astronomical science ? His observatory provided him with a refracting telescope of $10\frac{1}{2}$ inches aperture and 15 feet focal length, and with this instrument he made observations of Titania and Oberon—two satellites of Uranus—and hence deduced a value for the mass of Uranus in terms of that of the sun. Reduced to its simplest form, the calculation is, of course, simple. One writes down the force between the planet (P) and the satellite (M) as $G.PM/r^2$ and equates it to the mass-acceleration (Mv^2/r) of the satellite. A similar equation holds for the planet (P) and the sun (S) in terms of the velocity (V) of the planet and the radius (R) of its orbit. Hence, by dividing the two equations, we have the numerical value of the ratio P/S if we know the speeds and orbits of satellite and planet. Lamont's value for this ratio was 1/24905. Of the determinations made during his lifetime the most important are those of Bouvard who, in 1821, obtained the value 1/17918 from a consideration of the perturbations of Jupiter and of Saturn; of von Asten, who in 1871, working on observations of the two exterior satellites made by Struve, Lassell and Marth as well as those of Lamont, deduced the value 1/22020; of Copeland, in 1875, who, using Lord Rosse's telescope, found a value of 1/24000; and of Holden, in 1878, who, from observations made in 1875–76, obtained a mean value of 1/22600. Taking from modern tables the mass of Uranus as $87 \cdot 7 \times 10^{24}$ kilograms, and that of the sun as $1 \cdot 984 \times 10^{30}$ kilograms, the ratio is 1/22620.

In 1835 Lamont made a long series of observations on Halley's comet, and in 1836 he carried out observations on the second and third satellites of Saturn and deduced the elements of their orbits. He observed several total eclipses of the sun, and subscribed to the view that the red prominences were produced by clouds or other vapours in the earth's atmosphere.

Lamont has many claims to be regarded as a pioneer in the science of terrestrial magnetism, taking, as he did, a leading part in establishing that concerted system of magnetic observations which was inaugurated about 1840. The bent of his work is indicated by the title of the first paper which he devoted to this subject—"Bestimmung der Horizontal-Intensität des Erdmagnetismus nach absolutem Maase" and he followed this up by a long series of papers devoted to observations and instruments.

Lamont's most massive contribution to astronomical science is contained in a six-volume catalogue of telescopic stars, mainly of the eighth and ninth magnitudes. His labours were confined to a broad belt round the celestial sphere, extending from 27° N. to 33° S. of the equator of that sphere, although most attention was paid to stars on the belt extending from 15° N. to 15° S. of the equator. In this region no fewer than 34,764 stars were observed, their positions being mapped out in ten catalogues, each extending over a belt about six degrees in breadth. It may be remarked that on two occasions he unwittingly observed the planet Neptune—on October 25, 1845, and September 7, 1846. Galle's identification of the planet was made on September 23, 1846.

That, in brief, is the story of quiet achievement which the granite stone on Deeside will commemorate for centuries to come.

* I have not noticed, in the official obituaries which I have consulted, the title "Astronomer Royal of Bavaria" as representing Lamont's official position, which seems to have been that of "Conservator of the Royal Observatory".

Aluminium-Surfaced Mirrors in Astronomy

By Dr. H. SPENCER JONES, F.R.S., Astronomer Royal

IT appears probable that aluminium-surfaced mirrors will in time entirely displace silvered mirrors for investigations in the ultra-violet region of the spectrum and for astronomical purposes generally. The evaporation process dates back to the time of Edison who, in 1890, obtained patents in connexion with it. It was not until about 1928 that the advantages of the evaporation method for various scientific applications began to receive attention. At about this time, Hochheim, in Germany, evaporated an ultra-violet reflecting alloy consisting of 88 per cent of aluminium and 12 per cent of silver.

The process was perfected by R. Ritschl at the Reichsanstalt, particularly with the view of coating two interferometer mirrors simultaneously and equally to give the same reflecting power. The firm of Messrs. Adam Hilger, Ltd., was later instructed by Ritschl in the production of reflecting surfaces by the evaporation process. In the United States, the process was used in 1931 for small interferometer mirrors and filters by Dr. J. Strong, then of the University of Michigan, and Dr. P. G. Kruger, at Cornell University. Pure aluminium seems to have been first evaporated by Dr. Kruger. Dr. R. C. Williams suggested in June 1931 that the method be applied to large astronomical mirrors and tried chromium, which he found to give a hard, untarnishable film with fair ultra-violet reflectivity. The first astronomical application of the process was at the total solar eclipse of August 31, 1932, when a chromium-surfaced 15-inch mirror of the Lowell Observatory was used to obtain the spectrum of the corona.

Dr. H. Cartwright and Dr. J. Strong found that the evaporation process could be applied to many metals, including aluminium, antimony, beryllium, bismuth, calcium, chromium, cobalt, copper, gold, iron, lead, magnesium, nickel, selenium, silver, tellurium, tin and zinc; also to speculum metal and to substances such as quartz and fluorite. They protected a silvered surface with quartz, less than one wave-length in thickness, and found that it was quite immune from tarnishing when exposed to sulphuretted hydrogen. The coating of astronomical mirrors with aluminium was undertaken independently by Dr. Strong and by Dr. Williams in the autumn of 1932.

Some results obtained with these aluminium-coated mirrors have recently been published. With the 36-inch Crossley reflector, Dr. W. H. Wright has investigated the ultra-violet spectra of certain planetary nebulæ. The principal lines present can be divided into two groups, namely: $\lambda\lambda$ 3346, 3426 and $\lambda\lambda$ 3133, 3312, 3341 and 3445. In some nebulæ the first of these groups is relatively strong; in others, the second group is strong. The two lines of the first group have been identified independently by Swings and Edlén and by Bowen, from theoretical considerations, as forbidden lines in the spectrum of Ne V. The slitless images of these lines are the smallest in the whole nebular spectrum, indicating a high degree of ionisation. The lines of the second group are permitted lines in the O III spectrum; other O III permitted lines which might be expected to be present are not shown. Bowen has remarked that all the permitted O III lines which appear in the nebular spectra represent either a transition from the $3d\,{}^3P_2$ term or a transition from a term to which an electron can jump directly from this $3d\,{}^3P_2$ level. As the intensity variation of these lines from nebula to nebula follows the behaviour of the H II λ 4686 line more closely than that of the forbidden O III $\lambda\lambda$ 4959, 5007 lines, and as they are never observed when the λ 4686 line is missing, Bowen suggests that they are produced by fluorescent excitation. The $(2p)^2\,{}^3P_2 - 2p3d\,{}^3P_2$ transition of O III coincides closely with the resonance line of He II at λ 303·78. A quantum of this He II line can therefore disappear by excitation of an O III atom to the $3d\,{}^3P_2$ state.

The 15-inch mirror of the Lowell Observatory was aluminised by Williams and Sabine in August 1933, and the ultra-violet spectra of 97 stars, to the ultra-violet limit of atmospheric transmission, were photographed at the mountain station of the Observatory on San Francisco Peak at a height of 11,500 feet. The Huggins bands of ozone and additional bands to the ultra-violet were prominent. The microphotometer energy curves have been used for the derivation of the temperatures of the stars.

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Obituary

SIR EDGEWORTH DAVID, K.B.E., C.M.G., F.R.S.

BY the death of Tannatt William Edgeworth David, emeritus professor of geology at the University of Sydney, Australasia has been deprived of an outstanding personality among her men of science. Although a brilliant geologist, the very breadth of his interests to some extent reduced his output of purely geological work, while the intensity of his enthusiasms sometimes led him to conclusions that his colleagues could not accept. But his reputation rests upon a broader and surer basis than his contributions to geological science, considerable as they were.

The outstanding feature of David's early work with the Geological Survey of New South Wales was the exploration and mapping of the northern coalfield, which has since become one of the main assets of the State. In 1891, he left the Survey to become the head of the new Department of Geology in the University of Sydney. In his new post his genius as a teacher was soon made manifest, and the glamour of his personality attracted an ever-increasing number of men and women students to what rapidly developed into one of the most vigorous and flourishing schools of a progressive university.

It is from 1907, however, when Ernest Shackleton passed through Australia on his way to Antarctica on his *Nimrod* Expedition, that the imperial and international reputation of David dates. One of the characteristics of the Permo-Carboniferous rocks that contain the main Australian coal measures is the evidence of a glaciation which may be said to be comparable in extent and intensity with that of the antarctic continent to-day. This fact captured David's imagination, and with characteristic foresight and energy he seized the first opportunity of studying a continental ice-sheet at first hand. Shackleton was not a man of science, but he was himself an intelligent and imaginative man, and saw the value of such a recruit to an expedition that was not too well-equipped on the scientific side. David obtained leave from his University Council to accompany the expedition as far as its base. When the *Nimrod* sailed for New Zealand again she bore with her—not Prof. David—but letters explaining his absence and asking for an extension of leave the granting of which he had already anticipated. South Victoria Land remained his home for twelve more months, and the scientific success of the Expedition was assured from the day his decision was taken.

David's part in the Expedition is well known. He led the first party to climb Mount Erebus, the successful ascent being undertaken when winter temperatures were already setting in. He carried through a detailed survey of what has proved to be the most interesting of all the winter quarters occupied by the expeditions to East Antarctica. He planned and executed as comprehensive a programme of scientific work as the equipment at his disposal allowed. Where equipment was lacking he often improvised with success means of observing and measuring accurately those factors of the antarctic environment which he thought would best repay investigation. He crowned his work by undertaking at the age of fifty-one years the first sledge journey to the South Magnetic Pole, a journey which involved more than a thousand miles of man-hauling, and might well have taxed to the uttermost the fittest of men in the prime of life. That he was exceptionally fortunate in the physique and determination of his two companions does not in any way detract from his own share in planning and executing perhaps the second greatest man-hauling journey that has ever been performed.

Beyond all this, David's contribution to the expedition must be measured, not by his physical or mental feats, or even by his scientific discoveries, but by the influence of his character and personality upon his leader and his comrades. In name and fact he was Shackleton's chief of scientific staff, but he became his chief adviser in other things as well. To the rest of us he brought a new conception of what loyalty and friendship might mean. None of our problems was too small to merit his attention: none so difficult that he could not make a contribution towards its solution. Whether he was assisting with a plane table survey, freezing his rather shaggy eyebrows to the telescope of a brass alidade in a gale at $-30°$ F.; washing up after dinner with an inadequate ration of water; planning and installing a novel tide-gauge, adjusting the same gauge in a blizzard, or helping to rescue it from a sudden break-up of sea-ice; giving Dickens readings into the small hours in the winter night; or talking over with Shackleton the plans for the attack on the South Pole, the "Professor" was always equal to the occasion and always had some useful and original contribution to make. His courtesy and patience were only equalled by his good humour. Nearly all the good stories of the Expedition centre around one or other of these attributes, which were sometimes not without their trials to lesser men.

After the Expedition, Shackleton was cramped for money, and the publication of reasonably adequate scientific memoirs was almost wholly dependent on David's activities. He lectured all over Australia in search of funds, and he devoted a great deal too much of his own slender resources to the same end. Funds proved difficult to raise, and the memoir which was David's chief published contribution to geology did not appear until 1914. It still remains the chief authority on general antarctic geology, and that aspect of the work is David's alone.

When the War broke out, Prof. David was fifty-six years of age, but he threw all his energy into the recruitment and training of an Australian mining unit and, when the time was ripe, repeated his exploit of 1908 by accompanying the expedition overseas. In France he spent some busy months in congenial geological work on the Western Front, until in 1917 occurred the accident from which he never wholly recovered, although he was still to carry out many

years' useful work. When descending a well shaft to examine the rocks through which it had been dug, he fell some 70 feet and was very seriously injured. The two remarks he is reported to have made when he recovered consciousness are perhaps as characteristic as anything he ever said. His first was: "It was, I assure you, solely my own fault. No one else is to blame." Then, turning to the unfortunate officer in charge of the winch: "You let me down so fast that I was unable to make out the sequence of the strata as I went past."

After his recovery, David was attached as chief geologist to General Headquarters and there he remained until the Armistice, one of his duties, which caused him a deal of quiet amusement, being the location of underground workings to protect the General Staff from bombs. He returned to Australia in 1919, and the next news his friends in Europe had of him was that he had departed on camel-back on an expedition to Central Australia in company with another veteran geologist, Howchin, of the University of Adelaide, who must then have been more than seventy years of age.

The last years of David's life were shadowed to some extent by illness, by the controversy that arose over his claim to have discovered pre-Cambrian fossils, and by his failure to complete his last self-imposed task, the preparation and publication of a comprehensive account of Australian geology, which was the main preoccupation of the years after his retirement from the headship of his Department in 1924. In 1932 he fortunately published a geological map of Australia with a volume of notes as an instalment of the great work, which he was himself beginning by then to fear he had commenced too late. Two days before the announcement of his death, the present writer received a letter concerning a projected visit to Cambridge in the winter, when he hoped to spend some months at Clare, the college of his adoption there, completing his book, so that he was, as he would have wished, in harness to the very last. His country, the scientific world and a host of friends are the poorer by his death.

R. E. P.

Prof. C. O. Jensen

Prof. Carl Oluf Jensen, who died on September 3 at the age of seventy years, was professor of pathology and director of the Serum Laboratory of the Danish Agricultural and Veterinary School, Copenhagen. He was chiefly honoured, and will be best remembered, as the author of two classical papers in cancer research—the first in 1903 on the experimental propagation of an alveolar carcinoma of the mouse, and the second in 1909 on transmissible rat tumours.

Although the transmission of rodent new growths had previously been achieved by Moreau, Hanau, and L. Loeb, Jensen's researches are rightly regarded as the beginning of modern experimental cancer research. He showed that the new tumours arose from the intact cells inoculated, and not by a transformation of the tissues of the new host. He further investigated the conditions for survival of tumour cells outside the body, proving that successful transmission could be obtained with tumour material after three weeks' sojourn in the ice-chest. The prompt and complete confirmation of his results by Bashford and myself no doubt assisted the general recognition of the advance made by Jensen, but its fundamental nature was really established by Jensen's own work and by his free and wide distribution of tumour material. The award of the Walker Prize of the Royal College of Surgeons in 1906 was made in recognition of the value of these researches.

The transmissible rat sarcomas which formed the subject of Jensen's second paper are better known and have been propagated and used for investigation in every cancer laboratory in the world, but the remarkable circumstances of their origin have either been forgotten or ignored. They arose in two rats inoculated intraperitoneally with cultures of an acid-fast bacillus, a remarkable and unexplained observation which has never been repeated.

Jensen's only other contribution to tumour problems dealt with the transmissible tumours of the turnip and beet, later shown by Erwin Smith to be due to a microbe (*B. tumefaciens*) and now familiar as crown-gall.

In later years, administrative duties in connexion with Denmark's paramount agricultural industry absorbed so much of Jensen's time and energies that cancer research was perforce relegated to the background. His fame is secure and his memory will be cherished as long as men busy themselves with the fascinating problems of cancer.

J. A. Murray.

We regret to record the death on September 24, at the age of seventy-seven years, of Mr. C. Carus-Wilson, who will be remembered for his investigation of the phenomenon of 'singing sands'. So long ago as 1888, Mr. Carus-Wilson read a paper before the Bournemouth Natural Science Society in which he ascribed the production of sound by certain sands to the rubbing together of myriads of very smooth grains of quartz. In Nature of August 6, 1891, he described further experiments in which he succeeded in producing musical notes from appropriate sands in vessels of various shapes and sizes. He was able to show that Eigg sand in particular is musical in any vessel, whereas other 'singing sands', such as those of Studland Bay, emit sound only in highly glazed vessels of particular shape. A process of sifting, washing and boiling was also used to improve the emitting power of poorly musical sand. Mr. Carus-Wilson was a successful lecturer and writer on geological and other science subjects.

We regret to announce the following deaths:

Sir John Adams, from 1902 until 1922 professor of education in the University of London and principal of the London Day Training College, on September 30, aged seventy-seven years.

Prof. Adalbert Fernau, director of the Institute for Radium Technology at Vienna, on August 30, aged fifty-six years.

News and Views

Inventions and Patents

THE development of dormant and new inventions as a stimulus to economic recovery was the subject of a paper read by Sir James Henderson before Section G (Engineering) of the British Association at Aberdeen. The recent action of the Institution of Mechanical Engineers in appointing a committee to act as an advisory link between inventors and capitalists is a step in this direction which might well be followed by other similar societies and by the industries themselves, while the State should realise the important bearing that the industrial application of inventions might have on the problems of unemployment and future prosperity. The Government deserves the greatest credit for the encouragement it has given to the promotion of scientific research through the Department of Scientific and Industrial Research and the various research associations, but it is necessary also that at least as much practical encouragement should be given to promote the technical research needed to develop an invention to the commercial stage after its discovery in the laboratory. While it is not easy under present conditions to define what kind of stimulus the Government could or should give to attract the capitalist, or to assist an engineering firm to meet the cost and time involved in the transition of an invention from the laboratory to the factory, Sir James Henderson suggested that a good deal might be achieved if the Government would secure that the expenditure incurred by a firm, not only on its research laboratory but also on the technical development of an invention as far as the manufacturing stage, should be reckoned as working costs and be exempted from income tax. The risk that the resultant loss of revenue might not be completely balanced by additional receipts due to an improved industrial position might well be taken.

ON the other hand, Dr. Herbert Levinstein, in an article which appeared in the jubilee number of the *Journal of the Society of Dyers and Colourists* and now available separately, urges that for the protection and advancement of British industry a reform in our Patent law is necessary, under which the Patent Office would have the power to refuse an application for a patent on the ground of insufficient subject-matter or want of inventive step, from which decision there would be no appeal, and a patent once granted would be immune from subsequent attacks on those grounds. Dr. Levinstein pleads that the only reason for granting patent monopolies is the introduction of new industries into the country, and a state of affairs under which a very large number of the patents sealed by the Patent Office prove to be valueless and only serve to block the way can be remedied by giving to the Comptroller the extended powers that are now exercised only by the Courts when the validity of a patent is called in question, so that the decision as to whether in fact there is invention or merely an alleged invention would be made before the grant of the patent and not after. The elaborate and expensive investigation usually deemed necessary in the Courts before the question of subject-matter of a patent can be decided will lead many to doubt whether Dr. Levinstein's suggestion would not introduce serious complications at a stage when the commercial value of a patent was quite unknown. The matter was, it will be remembered, ventilated before the Board of Trade Departmental Committee on the Patents and Designs Acts which reported in 1931, and received no encouragement from the Committee.

Drainage of the Fen District

A SIGNIFICANT event in the long history, covering a period of 300 years, of the struggle to master the problem of the drainage of the Fens, took place on September 28, when Mr. Walter Elliot, Minister of Agriculture, inaugurated the new sluice and pumping station at St. Germans, Norfolk, which, by its ability to discharge up to 3,000 tons of water per minute, will materially relieve the difficulties which have hitherto attended the drainage of the Middle Level, an area of 173,000 acres lying between the Rivers Nene and Ouse. The greater part of the Fen District consists of peat and, by reason of its reclamation and adaptation to agriculture, the soil has dried and shrunk, causing settlement averaging half an inch per annum, but attaining as much as 6 feet in some places during the last fifty years. Simultaneously, the River Ouse has been gradually silting up, making it impossible in times of flood for inland water to gravitate to the sea, and necessitating the employment of pumps to raise the water to enable it to escape. The new sluice is the third which has been installed, its predecessors, the first of which dates back to 1848, having proved insufficient to cope with the volume of tidal water to be excluded. Advocated after the disastrous flood of 1912, the present scheme, which has cost about £224,000, did not take shape until 1929, when, on the advice of their chief engineer, Major R. G. Clark, the Middle Level Commissioners decided to proceed with the work to his design, which incorporated a pumping system of three units. Mr. Elliot described the pumping machinery as "the biggest in the world—more powerful than anything in Holland, the great land of dams, engineers, and water pumps". The four sluice gates provided are designed to withstand and operate against a maximum difference of head of 30 ft. from the Ouse side and of 17 ft. from the drain side. The weight of each gate is approximately 28 tons.

A Suggested Locomotive Testing Station

ON many occasions, proposals have been put forward for the erection in Great Britain of a national testing station for locomotives, similar to those in the United States, France and Germany, and the

matter was discussed by a committee of inquiry appointed by the Department of Scientific and Industrial Research. The latest of the testing stations built abroad is that at Vitry-sur-Seine, near Paris. A description of this station appeared in *Engineering* of August 4, 1933, and it was the subject of special notice in Mr. H. N. Gresley's presidential address to the Institution of Locomotive Engineers delivered on September 27, in which he made a vigorous plea for a similar plant in England. Of the usefulness of such a station, he said, there can be no doubt. The requirements of the export trade in locomotives and the conditions of railway transport at the present day indicate the need for better facilities for the scientific study of the locomotive than are generally available in Great Britain in order that improvements in design, resulting in a higher standard of thermal efficiency and economies in fuel consumption, might be effected. Mr. Gresley described the station at Vitry as the most perfectly equipped in the world. The plant is designed to test locomotives having an axle load up to 30 tons running at all speeds up to 100 miles per hour. The hydraulic brakes for the testing bench, which were made by Messrs. Heenan and Froude, Worcester, can absorb up to 7,200 horsepower. The total cost of the station was £120,000. Mr. Gresley advocated a similar station for Great Britain, to be financed by Government, which might set up an organisation under the Department of Scientific and Industrial Research for its control, with power to levy fees for its use.

Photoelectricity in the Theatre and on the Road

A PAPER read by Dr. N. R. Campbell and Mr. C. C. Paterson to Section A (Physical and Mathematical Sciences) of the British Association meeting at Aberdeen on September 11 described the vicissitudes of the photoelectric cell during the sixty years since it was invented. The development of the cells was almost complete forty years ago, but, with the exception of a few men of science, no one took much interest in them until ten years ago. Apparently photoelectricity had arrived before the world was ready for it. The invention of the sound film created a great demand for photoelectric cells. Formerly, they were made in ones and twos by laboratory workers. Now they are demanded in thousands, and it is well worth the while of large industrial firms to manufacture them and develop them further. The obstacle to their extension that had to be overcome was, not lack of technical power, but simply ignorance on the part of those that might use them. Engineers had not yet recognised the many important purposes to which they could be put. The great rapidity of their action made them most useful for timing races. If a speed limit were imposed by the new Traffic Act, photoelectric cells could be used to make it effective. There is no difficulty in timing a car over 15–20 feet without any possibility of human error.

Classification of Stone Age Cultures

WE have received a communication from Messrs. J. Reid Moir and J. P. T. Burchell in which they criticise the methods of classification adopted in the arrangement of the special exhibit, now on view at the British Museum, illustrating the cultures of the Old Stone Age. The system, which, in their opinion, clearly has a geological basis, in the main is that recently put forward by Dr. L. S. B. Leakey, and the points to which criticism are directed relate to the differentiation and arrangement of the earlier stages of that schematisation. The writers maintain that the tripartite division of the sub-crag implements, one division being named 'Icenian', a name suggested by Sir E. Ray Lankester for the whole group of pre-crag artefacts, has no relation to the facts as disclosed by recent investigation, but not yet published. Further, exception is taken to the equation of 'evolved Clactonian' (that is, High Lodge) with implements of Lower-Middle Acheulean antiquity, when the latter are demonstrably, on geological evidence, prior in date; while it is pointed out that no mention is made of recent work showing that Coombe Rock was immediately followed by the Middle Mousterian cultures of Crayford and Northfleet. Again, it is said, certain specimens from below the sand of unknown origin at Ivry Street, Ipswich, are erroneously labelled "flakes from the English Brown Boulder Clay". More generally, the whole classification of the earlier cultures into 'hand-axe' and 'flake' industries is regarded as invalid, as here in Great Britain, at least, these often occur on undisturbed floors in intimate association and are beyond doubt contemporaneous. Moreover, it is common knowledge that large numbers of hand-axes are themselves made from flakes.

MESSRS. REID MOIR and Burchell pay a well-deserved tribute to the character of the exhibit, for which they credit the chief responsibility to Dr. Leakey. This special exhibit of stone age cultures, however, is intended to bring before the public new views and to stimulate discussion; and although Dr. Leakey helped to prepare a scheme of classification of stone age cultures for submission to the recent International Congress of Anthropological and Ethnological Sciences, his views are not all peculiar to himself. It must also be pointed out that while the writers' main criticisms of the classification attempted have a chronological basis, the principle of classification is cultural. The chronological relation of members in two parallel, but independent, developmental series is irrelevant for this purpose, even though specific types equated as occupying analogous positions in the series can be shown to be, and admittedly are, widely separated in chronological succession. On the other hand, the criticism of the distinction drawn between the 'hand-axe' and 'flake' industries on the ground of their intimate association and contemporaneity argues neither for nor against the validity of the interesting hypothesis of two cultures of independent origin and lines of development; but neither does it preclude its possibility. In default of published evidence, the weaknesses of the tripartite division of the pre-crag industries have still to be demonstrated; but Mr. Reid Moir himself has argued on several occasions for the cultural

differentiation of these implements, and from this has inferred a difference in racial origin.

The Cable Repair Ship H.M.T.S. *Monarch*

IN connexion with 'Telephone Week' (October 1–6), members of the general public had an opportunity of inspecting the Post Office cable repair ship *Monarch,* which was lying in the Thames off the Tower. This ship is fitted out with the special gear necessary for carrying out all the operations required in cable laying and repair, on which service she is at sea for most of the year attending to cables such as those laid between Great Britain and the Continent. The positions of cables are charted so that a faulty section or broken cable may be located and raised by means of grappling gear, of which there are various types provided. The ship's testing laboratory contains apparatus for the measurement of conductor resistance, insulation resistance, localisation of faults and other tests applied to the end of a cable which has been hauled on board. Sections of defective cables are replaced by lengths of new cable, a supply of which is carried in the ship, and the repaired cable relaid and charted, a somewhat noticeable feature of the cross Channel cables being the large number of repairs marked on the charts. The ship is provided with wireless equipment including a valve transmitter and, in reserve, a quenched-spark transmitter. In addition to an ordinary receiver there are a directional receiver and an emergency automatic call which rings an alarm bell, when the operator is not on watch, as soon as it responds to three 'longs', of four seconds duration, out of the twelve sent for the S O S signal. The chart house contains an echo sounding device. The ship's complement is 14 officers and 50 ratings, this large number being required on account of the technical duties, in addition to ordinary duties, carried out on board.

Telephone Statistics of the World

IN *Electrical Communication* of July the telephone and telegraph statistics of the world have been published up to January 1933. The United States have now 53 per cent of the total number of telephones in use in the world, Canada has 4 per cent, Germany 9 per cent, Great Britain 6·5 per cent, France 4 per cent, the remaining European countries 14 per cent and all other countries 9 per cent. In January 1928, the United States had 60 per cent and Europe 28 per cent as compared with 33·5 per cent now. Whilst the number of telephones in Europe has increased by about 20 per cent during those five years, the number in the United States has diminished by 12 per cent. San Francisco leads the world with 36·5 telephones per 100 of the population and Washington comes next with 33·3. Stockholm is third with 31·8. In Canada, Toronto has 25·6 and Vancouver 28·1. Paris has 15, Berlin 11·1 and Munich 10. London heads the cities in Great Britain with 8·8 and Edinburgh comes next with 6·9. Honolulu, with a population of 138,000, has 11·7 telephones per 100. Whilst the United States have 70 miles of telephone wire per 100 of the population, Canada has 48, Australia and New Zealand 39, Sweden has 32·7 and Denmark 31·5. Germany has 23·2, Great Britain and Northern Ireland 22·6 and France 10·7. India and China have only 0·11 miles of telephone wire per 100 of the population. Czechoslovakia, the United States and New Zealand use their telephones more than other countries. The telephone conversations per capita in these three countries in 1932 were 224·5, 204·6 and 205·8 respectively. This compares with 33 in Britain and Germany and 20·5 in France. The number of conversations by telephone now averages about 100 times as many as of communications sent by telegraph.

Social Sciences in the United States

THE social sciences and, especially, applied social science or civics, figure prominently in discussions of current educational policies in the United States, as witness the monthly Educational Review published as a supplement to *School and Society* of July 7. An advanced school of thought has lately found an exponent in Richard Welling, whose "Civics as it should be taught" has provoked discussion about the courage needed by teachers to teach "the real facts about distorted democracy", and led to a proposal to form a union to teach civic truth and to protect anyone who does it. A new monthly journal of educational criticism and reconstruction is to appear this month under the name of the *Social Frontier* (2 dollars annually, 66 West 88th Street, New York) to be devoted to "serving the emerging consciousness among American teachers that they must participate fully in social processes reshaping the American order". The report of the American Historical Association's commission on the social studies has, after repeated revisions, reached its final form, a compromise between conflicting views (New York: Charles Scribner's Sons. 170 pp., 1.25 dollars). It calls for increased emphasis on social instruction from the kindergarten upward and extending to the adult population, and it stresses the need for a more realistic approach with frequent interpolation of the question: How is it in your own town, city, country? The principal article in the same issue, entitled "Cultural Objectives of Health Education" by the professor of public health, Yale School of Medicine, urges that teachers should bear in mind that they are educating citizens and not merely doctors or lawyers or farmers, or stenographers or salesmen or bank presidents.

Research in Industrial Health

THE fourteenth annual report of the Industrial Health Research Board up to June 30 emphasises, as have previous reports, that, "the study of the physiology and psychology of the worker is to reveal as many problems as are solved: to the fundamental problems becomes added that of overcoming difficulties in methods of approach and in technique". Trustworthy data about the incidence and kind of ill-health from which the workers in different occupations suffer are a pressing need. In the introduction to the report is a discussion of some of the difficulties in the way of obtaining data. An account of the chief problems now being investigated is given in outline.

Among the environmental conditions are lighting, noise, dust, heating and ventilation, the relation of warmth to comfort, and a special study of infra-red rays and comfort. Under the main heading of the physiology and psychology of work are mentioned an extensive survey of the physique of men in different industrial occupations, a study of incentives in repetition processes, sickness absenteeism and labour wastage, vocational suitability with special reference to accident proneness, and a study undertaken in co-operation with the Ministry of Labour dealing with the factors involved in employability among boys. In the conclusion it is pointed out that while there are signs of the practical application of much of the knowledge obtained by the Board, yet much more use could be made of the available knowledge, and also that many more problems remain to be investigated.

The Educational Machine

DR. JOHN MURRAY, in an article in the *Hibbert Journal* (32, No. 4), suggests that education is nowadays disliked not by children or teachers but by an increasing number of people outside the schools. The most dangerous of these are the materialists who think that education is too expensive, and in any event of doubtful value. Then there are the people in a hurry, who either want the children to start earning early or to learn their craft at school. Dr. Murray thinks that technical training is given better in the workshop than in the school, and that it is unfair to blame our present academic system until the generation it is training has reached middle age. Education to-day is unpopular also with those who dislike the educational machine—which is certainly cumbrous and in need of criticism—and with those who value character more highly than intelligence, and deplore the modern emphasis on interest rather than discipline. Finally, education is blamed for all those qualities which old people dislike in the young: but, as Dr. Murray points out, the 'bright young people' have existed in all ages and their energy is the motive power of society. Earlier marriage, rather than less education, would remedy their stability.

Reproduction of Graphs

FROM time to time, reference has been made to the fact that section paper ruled black is not a stock article, and that such paper would be advantageous for the preparation of graphs for reproduction as lantern slides or by printing. Mr. W. A. Young, who discussed the preparation of illustrations for a paper (*Proc. Inst. Heat. and Vent. Eng.*, 8, 79 and 127; 1907), records that as black was unobtainable he procured—not without difficulty—some paper ruled in red, but he found that it did not reproduce properly and concluded that the only satisfactory method was to trace a plotted curve, squares and all, in Indian ink. Mr. M. E. J. Gheury de Bray, First Avenue House, High Holborn, London, W.C.1, informs us that, being unable to obtain black ruled section paper, he has undertaken its production himself and can now supply it on paper and on card. Mr. A. F. Dufton, Greenbank, Garston, Hertfordshire, referring to this question, points out that "section paper ruled *yellow* is admirably suitable for reproduction. When photographed on a process plate, yellow reproduces like a full black. Paper ruled yellow, moreover, can be obtained without difficulty. It may perhaps be pointed out that an ordinary graph is not usually suitable for reproduction as it stands. The co-ordinate grille, printed in yellow, blue or green, appears as a mere background upon which black lines stand out boldly, but when reproduced in black it becomes unduly prominent. For reproduction, therefore, a graph should be drawn upon a grille of as coarse a mesh as practicable".

Forestry in Italy

IN *Forestry* of June 1934 is an article entitled "The Fascist Government and the Restoration of Italian Forests" by Prof. Aldo Pavari, director of the Royal Experimental Station for Sylviculture, Florence. Prof. Pavari deals with the forest problems in Italy, Italian forestry policy from 1887 to the march on Rome in 1922, Fascist forest legislation, the National Trust militia and instruction and experimental work in forestry. Of the total area of Italy, 31 million hectares, only a little more than 2½ million hectares are unproductive, that is, water, roads, buildings, sterile mountain slopes and crests, etc. Of the remainder, about 53·8 per cent is under agriculture, 26·7 per cent is pasture land of varying quality and 19·5 per cent, or 5½ million hectares, is covered by forest. These area totals are of importance in a mountainous country like Italy, which has vast areas subject to erosion as a result of the geological formation, whilst having at the same time an irregularly distributed rainfall. A general survey of soil conditions in Italy shows that, while the plains are intensively cultivated and the hills fertile, with vineyards, olives and other tree crops, the mountains have scarcely any woods and are generally in a low state of productivity. The so-called 'productive mountain pastures' are often nothing more than coppices, where constant grazing leads to progressive degradation and erosion of the soil, and thus the importance of erosion and floods increases from year to year with tragic consequences for the mountains themselves as well as for the hills below, leading to a constant destruction of the nation's resources and wealth. The measures by which the Duce proposes to improve the existing state of affairs are explained by the following three clauses of the Fascist Forest Legislation: "(*a*) To secure and defend the stability of the soil and the regularity of the water supply. (*b*) To aid the development of a rural economy in the mountain districts by encouraging sylviculture and the improvement of mountain fields and pastures. (*c*) To co-ordinate the whole complex action of the amelioration of the mountain districts with the reclamation of the hills and the plains".

The 'Isolated Basins' Electricity Scheme, Upper Egypt

EGYPT has a population of about 15 millions, and for the most part they are dependent on the land for their livelihood. The intensive development of the

comparatively small area of fertile land is of great importance. Since the rainfall is almost negligible, the irrigation of the country depends on the Nile. The Delta provides part of Egypt with a complete system of natural canals, and so it is possible to irrigate this part of Egypt at any time of the year and thus two or three crops can be grown annually. Along the banks of the Nile are situated a number of fertile areas called 'isolated basins' separated from one another by desert patches extending to the river's edge. The Nile is low for three months every year. It begins its rise of approximately 20 feet in May and from August to October all the isolated basins are flooded. When it subsides, one crop can be raised. Further irrigation is provided by primitive native water elevators, the water being elevated from wells and discharged into channels leading to the fields. The Egyptian Government has decided on an electrification scheme which will enable the land to be irrigated and drained in an adequate way. The contract for the supply and erection of the necessary overhead transmission lines, some of which are carried by towers across the Nile, others in underwater cables, has been given to the General Electric Co. by the Egyptian Government. In the *G.E.C. Journal* of August, a full description is given of the scheme by C. S. Ickringill and H. Peters. Power is generated at 3,300 volts, stepped up to 33,000 volts and transmitted to the pumping stations. A photograph is shown of the two lattice towers supporting the power cables across the Nile at Idfu.

Increasing the Speed of Atlantic Liners

FIVE years ago, four of the turbine vessels of the Hamburg-Amerika line were equipped with new turbines and water-tube boilers, so as to increase their output from 15,000 to 28,000 horse-power. This effected an increase in the speed of the vessels from 16 to 19·2 knots and reduced the time taken from Cherbourg to New York from 8 to 6½ days. The results of experiments and tug tests carried out with a model of the ships by the Hamburg Shipbuilding Testing Federation showed that considerable economies could be effected in the fuel consumption by altering the shape of the vessels. It was decided to increase their length by about forty feet and reinforce the hull structure so as to make it similar to the *Europa*. It is computed that the saving thus effected will in three years' time compensate for the total cost of the reconstruction, which was carried out by Messrs. Blohm and Voss of Hamburg. During last winter, the vessels were withdrawn from service one after the other and new bows were fitted. As these bows had been previously constructed, the time that each vessel remained in the dockyard did not exceed 60 days. The old bow was burned away from the hull by oxy-acetylene blowpipes and the new bow was drawn towards the hull and kept in position by grappling irons. All the shell plates were electrically welded together and also nearly all the other connexions, including the floor plates, pillars and girders. Interesting illustrations of electric-welded ship construction by Messrs. Blohm and Voss are shown in *Electric Welding* of August.

'Dry Ice' in the Machine Shop

BY means of solid carbon dioxide, often called 'dry ice', it is easy to lower the temperature of a piece of metal to 100 degrees below zero Fahrenheit. At this temperature, the metal contracts considerably and so the workman can obtain a good 'shrink fit'. It is analogous to the riveting of boiler plates by red hot rivets, which on cooling draw the plates so tightly together as to form a joint impervious to high pressure steam. According to Science Service of Washington, W. H. Swanger of the U.S. Bureau of Standards, who has been conducting experiments with solid carbon dioxide, reports that machine shop practice may come to accept this new method of shrinking metals. When a metal band has to be slipped round a shaft it is necessary to heat it, and as it cools it contracts to a tight fit. Instead of doing this we can refrigerate the shaft causing it to contract, and thus enabling the band to be slipped in place. When the shaft warms to room temperature a tight fit is secured. As the domestic production of frozen carbon dioxide has in recent years exceeded 40,000 tons it is commercially available. Mr. Swanger concludes that the shrinking of metals with very low temperatures is commercially feasible.

Speculative Borings in the Earth's Crust

THE heat generated in the interior of the earth's crust has puzzled men of science for centuries. In recent years, radical changes have been made in the theory of what causes this heat. A modern theory is that there is no heat from radioactive materials at greater depths than 12 miles. Heat is also due to the oxidation of iron and friction of slipping rocks. The present high price of gold has turned the attention of South African engineers to the possibility of boring their mines deeper. In the *Heaton Works Journal* of June an interesting account is given of the work done by Sir Charles Parsons in this connexion, and on the proposals he made for sinking a bore hole 12 miles deep. He proposed an arrangement of brine-cooling by large steel pipes connected at the top and bottom of each half mile section by a closed ring. There would be air-locks also every two or three miles so as to prevent the air pressure from becoming excessive. The real difficulty in the way of boring a hole to a great depth lies in the cost of the undertaking, and in the fact that a financial return cannot be guaranteed. Practically the only inducement to business men to explore the depths of the earth by sinking a deep hole is the chance of finding rich deposits of precious metals. If this is ever done it would put the speculations of men of science to the acid test of practice.

Rabbits and Steel Traps

ONCE again the R.S.P.C.A. rabbit week in Great Britain (October 6–13) is being made the occasion of an effort to obtain support for the Bill promoted by the University of London Animal Welfare Society to prohibit the import, manufacture, sale, exposure for sale, possession, custody or use of steel traps or gins. This Bill has now reached the final stages of drafting, and

will be introduced early in the new session. Viscount Tredegar will introduce it in the House of Lords, while Mr. Linton Thorp has consented to take charge of it when it reaches the House of Commons. Apart from the humanitarian aspect of the steel trap problem, there is another which assumes national importance, inasmuch as it has a vital bearing on agriculture. To agriculturists, the rabbit is a pest, and its extermination would be of great benefit to farmers. Paradoxical as it may seem, the steel trap is beginning to be suspect as an exterminator—and this in districts which have hitherto been wedded to its use. In certain portions of Carmarthenshire and in Pembrokeshire, traps were not used before the War, and rabbits were kept down by other means; since the introduction of the steel trap, these districts are overrun with rabbits.

New Uses for Bone Glue

THE results of the competition organised by the International Association of Bone Glue Manufacturers ("Epidos"), with the object of extending the uses of bone glue, have recently been announced, and the sum of 30,000 Swiss francs has been distributed among thirty competitors representing ten Continental countries; the fact that this is 10,000 francs in excess of the amount to be distributed under the rules of the competition may be taken as an indication of the high standard of the contributions. It is remarkable that few of the winning memoranda refer to what is usually regarded as the obvious and most common use for glue, namely, as an adhesive. They are, indeed, characterised by the diversity of their interests, and include processes in which glue is used as a stabiliser for colloids (for example, in latex preparations, polishes and ceramic products); as a source of nitrogen in the production of yeast; to enhance resistance (for example, of rubber) to oils and spirits; and as a catalyst, for example, to inhibit the action of acid pickle-liquor. There also appears to be a wide range of uses for glue as an ingredient of plastics, moulding and insulating materials and lacquers, and as a dressing for textiles. Full particulars of each process are obtainable from the General Secretariat of Epidos, 40, Rue du Colisée, Paris. International competitions of this kind suggest a novel method of obtaining technical information which doubtless will prove popular with prospective inventors. In the present instance, the experiment certainly appears to have justified itself, since it is announced that a further competition will be organised in the near future.

B.D.H. Products

THE British Drug Houses Ltd., London, N.1, have issued a handy brochure entitled "B.D.H. Injections for Parenteral Medication". It contains a list of drugs which are commonly given by injection, a brief note of their use and the range of dosage recommended, together with the packings obtainable and their cost. It is stated that the preparation of the solutions is carried out in a specially designed room, provided with double doors and supplied with filtered air at a pressure slightly in excess of atmospheric. The ampoules and bottles used are made of standard alkali-free amber glass and are sterilised after filling by an approved method, the actual process adopted being one which exerts no deleterious action on the medicament. Where containers designed to permit the withdrawal of successive doses on different occasions are employed, a small quantity of antiseptic is added to the solution. "Glucotest Solution" B.D.H. provides a simple and rapid method for determining the amount of sugar in urine. 2 c.c. of the solution is boiled in a test tube with a small amount of Glucotest powder to prevent bumping and the urine is added drop by drop from a pipette. The addition of urine is continued until the blue colour of the liquid has completely disappeared and a white or yellow colour free from any suggestion of green remains. The amount of glucose in the urine is inversely proportional to the number of drops required, and is ascertained directly from a table supplied with the solution.

Cosmic Radiation

No. 4 of the *Annals of the Observatory of Lund*, 1934, is devoted to a memoir in English, entitled "Cosmic Ultra-Radiation in Northern Sweden (an Academical Dissertation)" by Axel Corlin. It is an admirably printed quarto volume containing 113 pages of text and 80 pages of tables and bibliography. The author made measurements of the cosmic radiation in the far north of Sweden, using a Kolhörster apparatus in 1929–30 and a Steinke apparatus in 1932–34. A careful study is made of the relation between the radiation measured, and the air pressure, air temperature and humidity, using the method of multiple correlation. No direct influence of air temperature and humidity was found. Likewise no positive relation was established, after exhaustive investigation, between the cosmic radiation and magnetic storms and auroræ. The transition effect in iron was observed in a lake near Abisko, with results similar to those found by Steinke at Königsberg. The ionisation by cosmic radiation was measured in the Kirunavaara iron mine, and was detected down to 700 metres water-equivalent. The volume contains two chapters of great general interest, one giving a historical summary of the experimental and theoretical development of cosmic ray investigation, while the other discusses the origin of the radiation, the present situation of this problem being described as "quite desperate".

Measurement of Geological Time

IN 1931, H. V. Ellsworth analysed a specimen of uraninite from Manitoba and obtained a lead-ratio with the surprisingly high value of 0·260, corresponding to an age of about 1,750 million years. Although Ellsworth gave adequate evidence that the mineral was of first class quality, there has naturally been some hesitation in accepting this great extension of geological time. Confirmation of the most convincing kind is now, however, forthcoming. It is announced by Prof. A. C. Lane through Science Service, Washington, D.C., that Miss Edith Kroupa (working in the laboratory of Dr. F. Hecht in Vienna) has

analysed a sample of monazite which occurred with the Manitoba uraninite. The age turns out to be 1,725 million years. The significance of this high figure may be realised when it is remembered that the 'Middle' Pre-Cambrian rocks of Ontario, Norway and India have an age of about 950–1,050 million years. Clearly there was time enough before this for at least three major cycles of mountain-building and igneous intrusion, of which only one has hitherto been generally recognised.

Fur-Farming in U.S.A.

ECONOMIC stringency in the United States of America threatened to put a stop to the experimental fur-farming carried on by the Bureau of Biological Survey of the Department of Agriculture, but the restoration by the committee of appropriations of a grant of 51,717 dollars which had been eliminated will enable the experiments to be continued (Science Service, Washington, D.C.). Fur-farming is perhaps the only live-stock industry which has been profitable in the United States during the past three years. In 1933, there were harvested 150,000 silver fox and 50,000 mink pelts, but the great difficulty has been found to be the over-all improvement of the quality of the skins, too many still being of inferior grade. Some thirty to thirty-five million dollars is invested in the industry.

Report of the Ordnance Survey

THE report of the progress of the Ordnance Survey for the year 1933 (H.M. Stationery Office. 3*s*. net) directs attention to the slow rate of revision in the field of the large-scale plans which is at present possible. During the last three years, revision has been largely confined to the area of Greater London, adjoining counties, Devon, Cornwall, parts of the West Riding and Manchester areas. But the greater part of England has not been revised for more than ten years and much is more than twenty years out of date. Wales and Scotland have been largely unrevised for at least twenty years. Progress is reported in the preparation of the new fifth or relief edition of the one-inch map, and six more sheets were published during the year. Archæological maps of the Trent Basin and the Old Sarum district were published. Other publications included the magnetic edition of the physical maps of England and Scotland.

Announcements

LORD MACMILLAN has been appointed a trustee of the Beit Memorial Fellowships for Medical Research in succession to the late Sir James Kingston Fowler. The other trustees are: Sir Alfred Beit, Mr. Wm. Ormsby Gore, Lord Onslow, Lord Rayleigh, Dr. Edwin Deller (principal of the University of London) and Sir John Rose Bradford.

PROF. A. J. CLARK, professor of materia medica in the University of Edinburgh, and Prof. J. C. G. Ledingham, director of the Lister Institute of Preventive Medicine and professor of bacteriology in the University of London, have been appointed members of the Medical Research Council in succession to Sir Charles Sherrington and Dr. A. J. Arkwright, who retired in rotation on September 30.

THE Lord President of the Council has appointed Sir John Cadman and Sir James Jeans to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Sir Arthur Balfour, Sir William Bragg and Lord Rayleigh have retired from the Council on the completion of their terms of office.

SIR HARRY LINDSAY has been appointed director of the Imperial Institute, South Kensington, London, to succeed Sir William Furse, who retired on September 30. Sir Harry Lindsay was formerly Director-General of Commercial Intelligence, India, and since 1923 has been Indian Trade Commissioner.

A SYMPOSIUM on "Technical Aspects of Emulsions" is being arranged by the International Society of Leather Trades' Chemists (British Section) to be held at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on December 7 at 10 a.m.–6 p.m. The morning session will be devoted to papers on the making of emulsions, and the afternoon session to papers on the breaking of emulsions. The symposium is open to the public. Further information can be obtained from the Organising Secretary, International Society of Leather Trades' Chemists, 17 Market Street, London, S.E.1.

THE Irish Radium Committee has published its report for the year 1933 (*Sci. Proc. Roy. Dublin Soc.*, 21, No. 7. July, 1934. Separate Issue). Radium therapy is carried out by means of radon tubes, of which 306 batches, containing 12,996 millicuries radon, were issued during the year. Reports upon 466 cases treated at four hospitals are included, but no conclusions respecting the results obtained are given.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A principal of the Belfast Municipal College of Technology—The Director of Education, Education Offices, Victoria Street, Belfast (Oct. 12). An inspector for the purposes of the Diseases of Animals Acts, 1894–1927, in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (Oct. 15). A head of the Science Department, Blackburn Municipal Technical College—The Director of Education, Education Offices, Library Street, Blackburn (Oct. 15). A professor of social science, and a lecturer in anatomy in the University of Cape Town—The Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (Nov. 7). A teacher of domestic subjects at the Technical Institute, Tunbridge Wells—Dr. J. Lister, Technical Institute, Tunbridge Wells. A micro-analyst in the Department of Organic Chemistry, University of Manchester—Prof. I. M. Heilbron. An assistant keeper in charge of the Oceanographical Collection in the British Museum (Natural History)—The Secretary, British Museum (Natural History), London, S.W.7.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Air Waves of Unknown Origin

WITH the object of investigating the passage of waves through the atmosphere to great distances, sets of hot wire microphones are maintained at a number of stations and operated when it is announced that heavy guns are to be fired. Most of the firing which can be utilised for the purpose takes place at Woolwich, but by the courtesy of the Admiralty it is sometimes possible to take advantage of firing by H.M. ships.

During May last, there were three occasions when firing in West Bay near Portland was anticipated and microphones were in operation at the recording stations. On the last occasion, May 29, the firing which was arranged to take place between 10 and 10.30 B.S.T. had been postponed for several hours but this was not known to the operators. No air waves were recorded at any of the stations except Nottingham, but there, in an interval of less than two minutes, from 10.59.35 to 11.1.19 B.S.T. nine distinct air waves were recorded. The spacing of these was rather irregular and there was a decrease in intensity from the first to the last (Fig. 1).

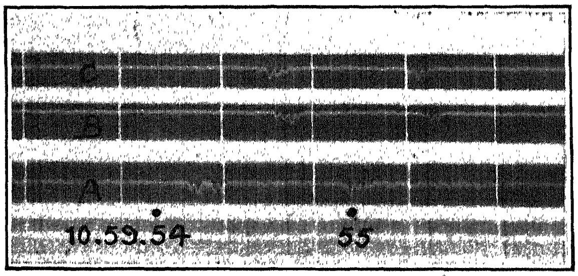

FIG. 1. Microphone records of air waves at Nottingham on May 29, 1934. Receptions 3 and 4. Microphone *B* is 243 m. 35° east of north of *A*; microphone C is 311 m. 14° west of north of *A*.

The station at Cefn Mably (Cardiff) was in operation up to 11.0.18. The records at Birmingham and Bristol had stopped at 10.49 and 10.40 respectively.

There are three microphones at Nottingham, so that, from estimates of the intervals between the receptions of waves, the bearing of the source of the waves and the inclination of the trajectory to the horizon can be determined. In this case the bearing of the source was 36° west of south and the angle of descent was 51°. Such a large angle of descent has never been recorded before and therefore the identification of the source is much to be desired.

A line through Nottingham on the correct bearing would pass through Plymouth and near Finisterre. It has been ascertained that there was no naval gun practice near Plymouth. Possibly there was firing near the French coast or blasting at quarries in Cornwall or in Brittany. It is likely that the waves passed over Cefn Mably at a great height. The extraordinary angle of descent of the waves implies that they must have attained a height at which the velocity of sound relative to the ground was about 550 metres per second. This is the velocity of sound in still air at about 1000° A. The alternatives are therefore offered. Was the temperature on May 29 at a certain height of the order 1000° A. (700° C.); was there a wind of the order 200 metres per second (400 miles per hour)? Did very high temperature and very strong wind co-operate?

If we knew where the explosions were produced and the exact times, we could determine approximately the height at which these remarkable conditions prevailed; it is therefore hoped that such information as to the explosions will be obtained. We should be grateful for any assistance.

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Supraconductivity and Fermi-Dirac Statistics

IT is an established fact[1] that the specific heat of some elements in the non-supraconductive state (zinc, silver) does not follow Debye's T^3-law at low temperatures. The deviations seem to be caused by a gas of free electrons, which follow the Fermi-Dirac statistics. So the specific heat of a non-supraconductive elementary substance is:

$$c_n = c\,T^3 + \gamma\,T, \tag{1}$$

γT being the specific heat of the free electrons according to Sommerfeld[2]. Now it is possible to derive thermodynamically the difference[3] between the specific heat of the supraconductive state (c_s) and c_n:

$$\Delta c = c_s - c_n = \frac{V\,T}{4\pi}\left\{\left(\frac{dH}{dT}\right)^2 + H\,\frac{d^2H}{dT^2}\right\}, \tag{2}$$

H being the threshold value and V the atomic volume at the temperature considered, or, by assuming the curve of the threshold values to be a parabola[4] ($H = -aT^2 + b$)

$$c_s = \left(c + \frac{3\,a^2\,V}{2\,\pi}\right)T^3 + \left(\gamma - \frac{a\,b\,V}{2\,\pi}\right)T. \tag{3}$$

Now experiments suggest that in the case of tin and thallium, c_s follows a T^3-law[5]. So the second term of the second member of equation (3) has no appreciable value:

$$\frac{a\,b\,V}{2\,\pi} = \gamma. \tag{4}$$

This relation can be verified (Table I). In the calculation of γ we assumed the number of the electrons per atom (n) to be equal to their valency. (If n does not equal the valency, the agreement is not so good, but n has only a relatively small influence, as γ is proportional to its cube root.)

TABLE I.

Element	a (gauss/°K²)	b (gauss)	V (cm.³)	$\frac{abV}{2\pi} \times 10^4$ (cal./°K²)	n	$\gamma \times 10^4$ (cal./°K²)
Tl	29·11	163·5	16·9	3·06	3	3·10
Sn	20·35	280·7	14·2	3·08	4	3·03
In	20·86	237·0	15·8	2·96	3	2·97

The agreement is surprising.

After substituting the formula $H = -aT^2 + b$ into Rutgers' formula[6] ($\triangle c = \frac{V\,T_s}{4\pi}\,(\frac{dH}{dT})^2$), we have :

$$\triangle c = \frac{a\,b\,V}{\pi}\,T_s = 2\,\gamma\,T_s \qquad (5),$$

(T_s being the transition point).

So it is possible to calculate $\triangle c$ without the aid of the curve of the threshold values. Again the agreement between experiment and calculations is striking in the case of thallium, tin and indium (see Table II).

TABLE II.

Element	$\triangle c$ observed (cal./°K)	$\triangle c$ Rutgers (cal./°K)	$\triangle c$ equation (5) (cal./°K)
Tl	0·00148	0·00144	0·00146
Sn	0·0024	0·00229	0·00225
In	—	0·00202	0·00203

From equation (4) we obtain: $ab = 8{\cdot}58 \times 10^3\ (n/V)^{\frac{1}{3}}$ gauss^2/°K^2.

The curves of the threshold values of mercury and lead are not parabolas, so in these cases our considerations break down.

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Photographic Intensity Measurements of Lines of the Paschen Series of Hydrogen in the Infra-Red Solar Spectrum

THE photographic photometric methods used in the Utrecht Physical Laboratory were applied to some important lines of the infra-red solar spectrum. For the nearer infra-red at about 10000 A., the Agfa plates "Rapid 960" were used, for the farther region at about 11000 A. the new Agfa plates with a maximum of sensitivity at 10600 A. The dispersion of the first order spectrum was 4 A./mm.

The lines of the Paschen series P_6 (transition $3 \rightarrow 6$) at 10938 A. and $P_7 (3 \rightarrow 7)$ at 10049 A. are directly visible on the plates as hazy absorption lines. This is not the case with the lines $P_8 (3 \rightarrow 8)$ at 9546 A. nor with the helium lines $2^3S - 2^3P$ at 10830 A. As these latter lines fall between strong lines (probably of atmospheric origin), only an upper limit for their central absorption can be given. It was found that in the Fraunhofer spectrum the central absorption of P_8 (9546 A.) is less than 6 per cent, that of the helium lines $2^3S - 2^3P$ (10830 A.) less than 5 per cent of the intensity of the continuous background.

Concerning the Paschen lines P_6 and P_7, the wings of the first are blended by weak lines whilst its centre is free from blends and corresponds exactly with the calculated place on the registrogram. The profile of the line can be easily determined by connecting the peaks between the blends. The line P_7, already identified in the "Revision of Rowland's Preliminary Table"[1], is free from blends, so that its profile can be determined in detail with greater exactness than that of P_6. It shows a slight asymmetry, namely, a stronger absorption at the red side. The profiles of both lines show the characteristic contours of pressure effect (Y-shape), as found by Unsöld[2] for the higher members of the Balmer series.

In these circumstances, if the re-emission of the light absorbed in the line can be neglected, it is possible, as Unsöld[3] has shown, to determine a lower limit for the number of atoms in the lower state from the total absorption of the lines by the equation

$$\int_0^\infty \log \frac{I_0}{I} d\lambda = \frac{\pi e^2 \lambda^2}{mc^2} . f . N_3$$

where I and I_0 are the intensities of the line and of the continuous background, and N_3 is the number of atoms in the third level above 1 cm.^{2} of the sun's surface. The f-values are taken from Sugiura[4]. The value found for N_3 from the line P_6 is $0{\cdot}028 \times 10^{15}$, and from the line P_7 $0{\cdot}064 \times 10^{15}$ atoms. The difference is caused by the fact that re-emission plays a greater rôle for P_6 than for P_7. Also the value from P_7 will be too small, but it should be near to the true value, for the values of N_2 calculated by Unsöld[3] from the Balmer lines, which converge for the higher lines to the true value, differ from it for the upper levels 6 and 8 only by factors of 10 and 2 respectively. There is another interesting fact. The Balmer line $H\epsilon$ falls in the strong absorption region of the line H of Ca^+. From the plausible assumption that the higher hydrogen levels are filled essentially by absorption of the Balmer lines, it follows that by the coincidence of $H\epsilon$ with the strong line H, the number of atoms in the seventh level and accordingly the re-emission from this level will be smaller than without this coincidence.

These considerations show that the conditions for the calculation of N_3 by the simple absorption scheme are fairly well fulfilled for the line P_7, so that the value of $N_3 = 0{\cdot}064 \times 10^{15}$ may be expected to be nearly correct. (Under simplified assumptions for the equilibrium of the levels, one can take into account quantitatively the re-emission and the influence of the close coincidence of the two lines $H\epsilon$ and H. This calculation gives a corrected value $N_3 = 0{\cdot}073 \times 10^{15}$).

From $N_3 = 0{\cdot}064 \times 10^{15}$ and $N_2 = 5 \times 10^{15}$ (Unsöld[3]) it follows that $N_3/N_2 = 1/78$ (for $N_3 = 0{\cdot}073 \times 10^{15}$: $N_3/N_2 = 1/68$). The assumption of thermal equilibrium of 5,000° K. for the sun's atmosphere gives with the Boltzmann formula $N_3/N_2 = 1/35$. Thus with respect to the degree of exactness of the values of N_2 and N_3, it can be said that the proportion of the numbers of atoms in the second and in the third levels is in good accord with a Boltzmann distribution of 5,000°. A similar fact was found by Merrill and Wilson[5] for stars of types B and A. The above result is remarkable because in the sun the proportion of the numbers of atoms in the second level and in the ground-level

(Unsöld[3]) differs from the Boltzmann distribution by the factor 10^3. A full account of this work will appear elsewhere.

I wish to express my thanks to the "Academisch Steunfonds" in Amsterdam for a financial grant and to both Prof. L. S. Ornstein and Dr. M. Minnaert for the facilities provided and many helpful suggestions. I wish also to thank the firm of Agfa for placing their excellent infra-red plates to the disposal of the laboratory.

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Effects of Polarisation in the Spectrum of β Lyræ

IT was suggested by me in a brief paper in 1929[1] that such polarisation effects as appear in connexion with resonance radiation may be present in some celestial sources of light. Comets and high prominences were mentioned by me as promising objects in this respect. As a matter of fact, observations made recently by B. Lyot[2] seem to give a proof of the existence of polarisation in the case of prominences.

Also, in the case of starlight, it seems possible that polarisation sometimes may appear, and notably for stars not having a spherical shape. Take, for example, a very much flattened, rapidly rotating star. If such a body is observed edgewise, we must expect the resonance radiation originating from the very edge to be partly polarised in the case of certain spectral lines. The theoretical value for the maximum degree of polarisation for resonance light from such an edge is found to be 33 per cent. This amount is, however, only to be expected for spectral lines giving complete polarisation when excited by parallel light. If the body is extremely flattened at the edge, there may also appear an accumulative effect in the production of polarised light.

Similar polarisation effects may appear in very elongated stars if they are so orientated that their longest axis is nearly perpendicular to the line of sight.

A star which appeared to me to be of special interest in this connexion is β Lyræ. It has been observed by me with the 40-inch reflecting telescope of the Stockholm Observatory since May 7 of this year for the purpose of trying to find polarisation effects. The instrumental arrangement is the same as that described in *Meddelande*, No. 12, of the Stockholm Observatory. The observations have been made in such a way that the spectrograph equipped with double image prism has been turned round the optical axis of the telescope, and a series of exposures have been made corresponding to different position angles of the slit. The star has been observed on 18 nights, and the total number of spectrograms which have been analysed is 117. Some of these are extraordinary images. Three different dispersions have been used corresponding to 9, 23 and 27 A./mm. at $H\gamma$. The spectrograms have all been analysed with a self-recording microphotometer.

A preliminary examination of the microphotometer tracings has given some interesting and rather puzzling results. *Faint effects of polarisation have been found to be present in the $H\gamma$ line*, but as to other spectral lines no clear effect has so far been found. The polarisation effects which have been observed appear in the *absorption contour* of $H\gamma$. That wing of this absorption line, which is situated on that side of the line centre which is opposite to the $H\gamma$ emission line, is somewhat deeper and broader for images corresponding to a certain position of the slit than it is for images taken in other position angles of the spectrograph. No polarisation effects are present in or near the principal minimum, but otherwise the effects have been followed during nearly all the period and also close to the secondary minimum.

It may seem surprising that the effects appear in an absorption contour and not in an emission line. The fact that the absorption wing is well developed in certain images but fainter in others can be explained in this way, however, that the contour is to some extent filled out by polarised light. As regards strong emission lines, the conditions are surely not very favourable for the production of polarisation if, as is generally believed, such lines result as emission by steps after absorption of light in the far ultra-violet. We have probably in such a case very little resonance radiation.

The observations give a determination of the plane of polarisation with an accuracy of about 10°; and they give a very remarkable result as to the orientation of this plane. They show that *the plane is not fixed in space but seems to be subject to oscillations*. The observations indicate a periodical variation with a total range of about 66° and a period of about 103 days. As yet the observations only cover one such period and the figures must therefore be considered approximate.

The real meaning of the observed effects is not very clear from the present material. It seems evident, however, that the polarisation originates in the primary *cB9* star revolving around the secondary *B2e* star because the effects appear in the oscillating asymmetric absorption wing.

A determination of the plane of polarisation would mean a determination of the equatorial plane in the case of polarisation effects at the edge of a very flattened or elongated body. But if the plane of polarisation is subject to a regular oscillation with respect to its orientation, this would lead us to rather phantastic conclusions; namely, either that the polar axis of the star has a very rapid precessional motion, or that the star shows a physical libration, or that the orbit itself is subject to disturbances from a third body. But this is difficult to understand when considering the regularity in the eclipsing phenomena. Maybe the effects are caused by gigantic prominences leaving the star at different zones at different times. We must content ourselves with speculations until much more extensive material is available.

The star is still observed regularly by me. Also some other similar objects and rapidly rotating stars have been put on the observing programme.

YNGVE ÖHMAN.

Stockholm Observatory.
Aug. 25.

[1] *Monthly Notices, R.A.S.*, **89**, 479; Uppsala Observatory, *Meddelande*, No. 43.
[2] *C.R.*, **198**, 249; 1934.

Light of Very Short Wave-Length (2100 A.) in the Solar Spectrum

FABRY and Buisson[1] have shown that the short wave-length limit of the spectrum of the sun near 2900 A. is due to the absorption by ozone in the atmosphere of the earth. This absorption of the ultra-violet Hartley band of ozone begins at the wave-length 3100 A. and reaches a maximum at 2540 A. (Läuchli[2]). It is important to notice that the absorption falls rapidly on the short wave-length side of the band. Edgar Meyer[3] first pointed out that this property of ozone gives an opportunity of observing sunlight in the region of 2100 A. Several investigators searched for this short wave-length radiation, but without any success[4]. The reason for this is mainly given by the fact that below 2600 A., the atmospheric oxygen is strongly absorbing over long distances[5], so that it is necessary to use extremely sensitive apparatus to detect any radiation of this wave-length.

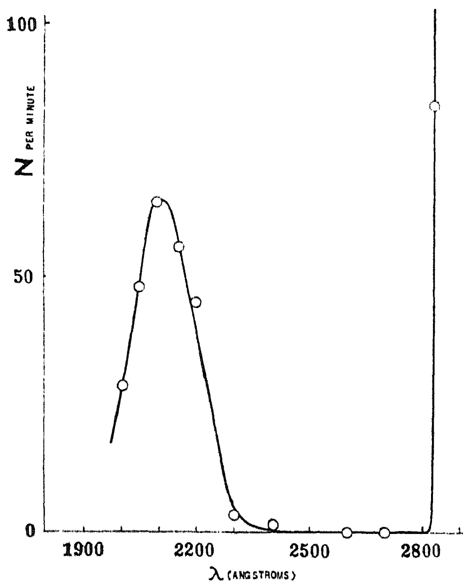

FIG. 1.

The researches of Schein and Stoll[6] show that it is possible to build extremely sensitive light counters for the ultra-violet, which enable very weak radiations to be measured. Such counters have been used to search for the above-mentioned radiation of the sun. On account of the absorption by oxygen in this spectral region the main experiments were carried out at great heights; at first in Arosa (1860 m.), afterwards at the Jungfraujoch (3460 m.).

A quartz monochromator was directed to the sun, and the radiation measured by a sensitive photon counter. The number of photons, which are proportional to the intensity of the radiation, were registered. A full description of the experiments will be given later in a more detailed paper.

The curve shown (Fig. 1) was obtained at the Jungfraujoch and shows the ultra-violet spectrum of the sun from 2000 A. to 2850 A. For these measurements a photon counter was used with a sensitive layer of platinum sputtered in an atmosphere of hydrogen. In the curve the number of registered photons is plotted against the wave-length in angstroms.

The curve obtained shows distinctly that in the short wave-length region of the ultra-violet a certain amount of sunlight reaches the earth's surface. The maximum intensity of this radiation lies at a point where the combined absorption of ozone and oxygen gives the greatest relative transparency of the atmosphere.

The following facts are characteristic of the intensity of this new radiation:

(1) It falls rapidly as the sun moves from the meridian to lower altitudes.

(2) It increases very much with the height above sea-level; at the Jungfraujoch we measured an intensity about a thousand times greater than at Arosa.

The more detailed discussion of these problems will shortly be published in a paper by M. Schein and B. Stoll in the *Helvetica Physica Acta*.

EDGAR MEYER.
M. SCHEIN.
B. STOLL.
Physical Institute,
University, Zurich.
Aug. 18.

[1] Ch. Fabry and H. Buisson, *Astrophys. J.*, **54**, 297; 1921.
[2] A. Läuchli, *Helv. Phys. Acta*, **1**, 208; 1928. *Z. Phys.*, **53**, 92; 1929.
[3] Edgar Meyer, *Ann. Phys.*, **12**, 859; 1903.
[4] Edgar Meyer, *Ann. Phys.*, **12**, 859; 1903. Edgar Meyer, *Verh. d. klimat. Tagung in Davos*, 1925. P. Lambert, G. Déjardin and D. Chalonge, *J. Phys. et le Rad.*, **4**, 536; 1923.
[5] H. Buisson, G. Jausseran and P. Rouard, *C.R.*, **190**, 808; 1930. **194**, 1477; 1932. F. W. P. Götz and H. Maier-Leibnitz, *Z. Geophys.*, **9**, 253; 1933.
[6] M. Schein and B. Stoll, *Helv. Phys. Acta*, **7**, 485; 1934.

Steric Hindrance and Geometrical Isomerism

IT is not often that evidence in the form of steric hindrance is available for confirming the configurations of geometrical isomers among ethylenic compounds. The following observations are thus of interest. *cis*-αβ-Dibromocinnamic acid[1] (m.p. 100°) esterifies to the extent of only 6 per cent in one hour, and 33 per cent in 16 hours, by the Fischer-Speier method, whereas the *trans*-acid[1] (m.p. 136°) is esterified completely in one hour. This is in conformity with my earlier observation[2] in regard to the different modes of addition of bromine to β-phenylpropiolic acid and its methyl ester.

cis-*o*-Nitro-α-bromocinnamic acid (m.p. 159°) has recently been prepared for the first time, in these laboratories, by Mr. J. D. Vasavada and me, as dense yellow rhombic tablets, by crystallising from benzene the unesterified portion of the acid product of the direct nitration of *cis*-α-bromocinnamic acid[3] (m.p. 120°). It has also been made from *o*-nitrocinnamic acid dibromide by the action of alcoholic potash and pyridine. In ten per cent choroform solution with a trace of free bromine, it is transformed with remarkable ease, by a few minutes exposure to direct sunlight, into the insoluble needle-shaped crystals of the *trans*-isomer[4] (m.p. 212°), which is capable of complete esterification in 1 hour. This and further work in this series will shortly be published elsewhere.

P. RAMASWAMI AYYAR.
Indian Institute of Science,
Bangalore.
July 20.

[1] *Annalen*, **247**, 139.
[2] Ind. Sci. Congr. Chem. Abstr., No. 75, 1934.
[3] *J. Chem. Soc.*, **83**, 668.
[4] *Ber.*, **24**, 251.

Effect of Light on the Reducing Substance (Vitamin C ?) in Milk

It has been reported in a previous letter[1] that milk which originally gives a positive vitamin C titration when the method of Birch, Harris and Ray[2] is applied fails to reduce the indophenol reagent after a short exposure to light (direct sunlight being excluded).

We have found at present that the property to reduce the reagent may be restored to about 90 per cent of the original value after short exposure to light (not more than 1 hour under our experimental conditions) by treating the milk with hydrogen sulphide and removing the latter from the trichloracetic acid filtrate in a way similar to that used by Tillmans, Hirsch and Dick[3] and Johnson[4] for the regeneration of reversibly oxidised lemon juice.

Longer exposures to light entail greater irreversible losses. Thus, after six hours, the hydrogen sulphide treatment restores only little more than half of the original value.

R. G. BOOTH.
S. K. KON.

National Institute for
Research in Dairying,
University of Reading.
Sept. 3.

[1] Mattick and Kon, NATURE, **132**, 446, Sept. 16, 1933.
[2] Birch, Harris and Ray, *Chem. Ind.*, **52**, 159; 1933. *Biochem J.*, **27**, 59; 1933.
[3] Tillmans, Hirsch and Dick, *Z. Unters. Lebensmitt.*, **63**, 267; 1932.
[4] Johnson, *Biochem. J.*, **27**, 1287; 1933.

The Ridge in the Indian Ocean between Chagos Is. and Socotra

In NATURE of July 7, p. 29, Dr. Hans Pettersson proposes that the submarine ridge running across the north-east Indian Ocean should be named after the late Prof. Johannes Schmidt. It should be pointed out, however, that the ridge in question has been baptised by Schmidt himself *Carlsbergryggen* (Carlsberg Ridge), the name taken from the Carlsberg Foundation, which fund made it possible for Prof. Schmidt to carry out the circumnavigation with the *Dana* (*vide* "Dana's Togt omkring Jorden 1928–1930", Copenhagen 1932, p. 255, fig. 198 B).

Å. VEDEL TÅNING.

Marinbiologisk Laboratorium,
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THE main reason why the name of "Johannes Schmidt Ridge" is preferable to that of "Carlsberg Ridge" appears to me to be that the former name conforms better with the traditions of oceanographical science than the latter. Ridges or depressions of the ocean floor have so far, where a geographical name already existing has not been used, almost exclusively been named, either after the ship from which they were discovered, or after some famous seafarer or investigator. There are, it is true, instances where geographical discoveries have been named after individuals or institutions in recognition of financial support. But in the present case, dealing as we are with one of the main features of the earth's crust, the name of its discoverer appears most appropriate, a name which Dr. Schmidt's modesty would, needless to say, have precluded him from putting forward himself.

HANS PETTERSSON.

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Göteborgs Högskola.

Lipolysis as a Source of Mitogenetic Radiation

AMONG the fermentative systems studied mitogenetically, the processes of glyceride hydrolysis, an important and widespread reaction in organisms, have hitherto not been examined. I have therefore examined lipolysis as a source of radiation. The methods of investigation are fully described in Prof. Gurwitsch's recently published monograph[1].

The following systems have been investigated: (1) tributyrin and monobutyrin from serum or pancreatic lipase; (2) triolein and lipase (pancreatic); (3) castor oil and ricinase (from *Ricinus* beans).

The spectral analysis has been carried out of the splitting of monobutyrin by pancreatic lipase. The diagram of the spectrum reproduced (Fig. 1) is based on more than two hundred experiments. The spaces, that is, the absence of radiation, correspond to differences between the induced reaction and the control and on an average do not exceed 3 per cent. The induction effects, where the average values have exceeded 15 per cent and in the majority of cases 20 per cent, correspond to the black bands of the diagram. Comparing Fig. 1 with the spectra of fermentative processes hitherto studied and published, we find that the spectrum of lipolysis (broken up into strips of 10 A.) has no components coincident to spectra already known.

FIG. 1.

We have also succeeded in showing that tributyrin, triolein and castor oil emit secondary radiation when irradiated by the monobutyrin system.

In a short series of experiments, we have made an attempt at applying our results to the analysis of biological processes, blood being taken as the subject. In five cases out of six we have discovered the lines corresponding to the lipolytic spectrum.

Full details of our investigations will be published elsewhere.

A. D. BRAUN.

Institute for Experimental Medicine,
Leningrad.
Aug. 20.

[1] "L'Analyse mitogénétique spectrale". Paris: Hermann et Cie, 1934.

Vibrations of the Ice-Cap of Polar Seas

In the course of the Polar expedition on the S.S. *Cheluskin* in the Chukchi Sea, 1933–34, I noted a very interesting phenomenon, concerning which I have been unable to find any descriptions in the literature available to me.

The solid ice-cap of the sea, which represents, as it were, an immense elastic plate on a liquid foundation, is in a state of perpetual vibration. Though I had no special seismic apparatus at my disposal, I was nevertheless able, by means of very primitive hand-made instruments, to detect and roughly to measure these vibrations. They proved for the most part to be caused by the wind, and the direction of the greatest amplitudes tallied with the direction of the prevailing wind. A few cases of considerable

vibrations running in a determined direction were observed on a windless day. Some hours later (up to eight hours) the wind blew in that same direction; evidently it did not keep pace with the sound oscillations it had created in the ice. We call those vibrations 'wind vibrations', but we admit that they may consist in a periodic warping of the ice-plate.

Besides these strictly directed 'wind vibrations' there may be observed 'disturbance vibrations' in the ice, spreading equally from the centre—the spot of the breaking up of the ice in different directions. A systematic investigation of the 'wind vibrations' would evidently greatly assist arctic synoptics. The study of the 'disturbance vibrations' will obviously permit periodicities in the dynamics of the ice-covered sea to be determined.

At present it is proposed to take observations of both types of vibrations by means of special ice seismographs, which will be set up on the shore-ice. There could be created, by means of blastings, artificial vibrations in the ice, and this method could be used also for the determination of the limits of the ice-fields, this too being of considerable practical importance in ice-navigation. The data obtained from seismological investigations of the ice would be of great help in the prognosis of ice conditions.

I take the opportunity to express my gratitude to Prof. O. J. Schmidt for his valuable advice given me in this work. IBRAHIM FAKIDOV.

Schmidt's Camp,
Chukchi Sea.
April, 1934.

New Type of Telegraph Repeater employing Carrier Currents

CARRIER currents have hitherto been employed, in the field of electrical communication, only for working simultaneously a number of telegraph and telephone channels over the same circuit. My recent investigations have shown the possibility of their application in an entirely new direction, namely, in the problem of 'repeatering' telegraph signals of various speeds, ranging from 25 to 400 words per minute.

The incoming telegraph signals are made to modulate a carrier wave of 5 kc./s. supplied at the repeater station. The modulated wave is then passed through a band pass filter to pass both the side bands, which are amplified by a power amplifier. The amplifier output is demodulated, passed through a low pass filter, amplified again by a single stage power amplifier and passed on to the next line section.

This type of telegraph repeater appears to possess many advantages over a mechanical telegraph repeater, which requires adjustment of polarised and neutral relays, automatic switches, etc. The overall current magnification is about 100 decibels and the wave-form of the amplified signals shows practically no distortion at all speeds of working. Further, the same power amplifier may be utilised for a number of telegraph channels passing through the same repeater station. Further investigations to develop this type of repeater are in progress.

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Aug. 10.

Induced Radioactivity

WHEN elements are bombarded with neutrons, we suggest that three types of reaction are possible, namely, simple neutron capture, disintegration with proton emission and disintegration with α-particle emission, the particular type of reaction depending upon the energy of the incident neutrons. Experimental evidence is now being published by various workers which seems to confirm these proposed reactions and also our hypothesis[1] that under neutron bombardment stable isotopes transmute to missing, unstable ones which are spontaneously radioactive, disintegrating with the emission of β-rays. For example:

$$_{13}Al^{28}\ (\text{unstable}) \rightarrow {}_{14}Si^{28}\ (\text{stable}) + \beta,$$

the Al^{28} being produced by the following reactions:

$$(a)\quad {}_{13}Al^{27} + n \rightarrow {}_{13}Al^{28},$$
$$(b)\quad {}_{14}Si^{28} + n \rightarrow {}_{13}Al^{28} + p,$$
$$(c)\quad {}_{15}P^{31} + n \rightarrow {}_{13}Al^{28} + \alpha.$$

Of these the second has been observed by Fermi, while Bjerge and Westcott[2] state that phosphorus under neutron bombardment gives rise to two radioactive isotopes, one of which decays with a period of 2·5 minutes. Since the period of radioactive aluminium, due to proton emission from silicon, is also 2·5 minutes, we conclude that both reactions (*b*) and (*c*) have been verified experimentally, the active product of short life from phosphorus being $_{13}Al^{28}$. Reaction (*a*) has not yet been confirmed.

Bombardment of phosphorus with neutrons of appropriate energy should give the following reactions, according to our theory of induced radioactivity:

$$(a)\quad {}_{15}P^{31} + n \rightarrow {}_{15}P^{32}\ (\text{unstable}) \rightarrow {}_{16}S^{32} + \beta,$$
$$(b)\quad \begin{cases} {}_{15}P^{31} + n \rightarrow {}_{14}Si^{31}\ (\text{unstable}) + p \\ {}_{14}Si^{31} \rightarrow {}_{15}P^{31} + \beta, \end{cases}$$
$$(c)\quad {}_{15}P^{31} + n \rightarrow {}_{13}Al^{28}\ (\text{unstable}) + \alpha.$$

Reaction (*a*) has not yet been observed experimentally, but we suggest that (*b*) and (*c*) explain the two decay periods obtained by Bjerge and Westcott with phosphorus bombarded by neutrons of various energies.

Additional confirmation of our hypothesis is given by the most recent work of these experimenters[3], namely, the formation of $_{11}Na^{24}$ by neutron capture. Fermi had previously produced sodium from magnesium and aluminium, so that all three reactions, by means of which Na^{24} (unstable and missing) can be formed, have been verified, namely:

$$(a)\quad {}_{11}Na^{23} + n \rightarrow {}_{11}Na^{24},$$
$$(b)\quad {}_{12}Mg^{24} + n \rightarrow {}_{11}Na^{24} + p,$$
$$(c)\quad {}_{13}Al^{27} + n \rightarrow {}_{11}Na^{24} + \alpha.$$

A full account of induced β-radioactivity, arising from these three types of reactions, for all elements will be published later.

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H. J. WALKE.

Physics Department,
University College,
Exeter.
Sept. 5.

[1] NATURE, 134, 64, July 14, 1934.
[2] *ibid*, 134. 177, Aug. 4, 1934.
[3] *ibid*, 134, 286, Aug. 25, 1934.

Photographic Desensitisers and Oxygen

IN the course of experiments on the tracks on photographic plates due to protons set in motion by neutrons, we have made some observations of more general interest. We found that the rows of silver grains marking the tracks of swift particles only appeared after development when the plate had been treated with pinacryptol-yellow or some similar substance and when the exposure to the particles was carried out in air at reduced pressure or in nitrogen. We therefore investigated the effect of light on photographic emulsions similarly treated and exposed in air at different pressures or in different gases. Our results may be summarised thus:

(1) The desensitisation is much reduced by (*a*) reduction of the air pressure; (*b*) by substituting pure nitrogen for air.
(2) This effect is not so marked when the plate is moist.
(3) The effect is apparent with pinacryptol-yellow, densitol, indulin-scarlet, phenosafranin, a mixture of pinacryptol-yellow and indulin-scarlet, antilumin and pinacryptol, but not with pinaflavol.
(4) A reduced pressure has no influence on plates not desensitised by one of the substances before mentioned.

That this effect has not been noticed by Mr. Shivonen[1] in silver bromide sols is probably due to essential differences in the experimental conditions.

From our experiments we feel entitled to draw the conclusion that the dye itself only plays an auxiliary part, probably that of a catalyser, in the desensitisation process, the major part being played by the oxygen of the air. These results, therefore, appear to us to support the well-known oxidation theory of desensitisation due to Lüppo-Cramer.

The details of our investigation will be published in the *Sitzungsberichte der Akademie der Wissenschaften*.

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HERTHA WAMBACHER.

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und
II Physikalisches Institut der Universität,
Wien.

[1] *Z. wiss. Phot.*, 24; 1926.

Energy of the C–OH Bond and Molecular Structure in Alcohols

A CONTINUOUS absorption spectrum in the ultra-violet region which corresponds to the immediate dissociation of the molecule into its constituents was investigated for a number of alcohols in the vapour state. The radical OH is generally considered as pseudohalogen, and the dissociation products are considered to be the excited OH radical and the normal alkyl residue, analogous to a halogen-alkyl. So the dissociation energy in the accompanying Tables I and II, estimated from the absorption edge, must be modified, if the energy necessary to excite the OH radical is known. The data are not so accurate as the absolute values, but they seem to have a definite physical meaning as relative values and to be of sufficient interest to warrant publication.

A comparison of the results obtained with the series of alcohols reveals certain interesting features on the relationship between the dissociation energy of the bond and the structure of the molecule.

TABLE I

Alcohols	Diss. Energy (kcal./mol.)	Raman Lines $\Delta\nu$ (cm.$^{-1}$)
CH_3OH	133·6	1225
C_2H_5OH	137·5	1272
n- C_3H_7OH	140·9	1282
n- C_4H_9OH	141·9	1286
n- $C_5H_{11}OH$	142·3	
n- $C_6H_{13}OH$	142·7	
n- $C_7H_{15}OH$	143·4	
n- $C_8H_{17}OH$	144·5	
n- $C_{10}H_{21}OH$	150·2	
n- $C_{12}H_{25}OH$	152·2	

TABLE II

Alcohols	Diss. Energy (kcal./mol.)	Raman Lines $\Delta\nu$ (cm.$^{-1}$)
n- C_4H_9OH	141·9	1286
iso- C_4H_9OH	141·2	1264
sec.- C_4H_9OH	140·2	—
tert.- C_4H_9OH	141·2	1202

(1) The energy of the C–OH bond increases successively as we go up the series of normal alcohols.

(2) In the isomers, no regularity appears among the energies of the C–OH bonds. It seems to assume the maximum value for the corresponding normal alcohols.

In connexion with the study of absorption in the ultra-violet region, it may be also worth while to compare the preceding results with the investigations of the Raman spectra of the corresponding alcohols. According to S. Venkateswaran and S. Bhagavantan[1], precisely the same relationships hold good in the series of alcohols as shown in Tables I and II.

Y. HUKUMOTO.

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Sendai, Japan.
July 20.

[1] S. Venkateswaran and S. Bhagavantan, *Ind. J. Phys.*, 5, 129; 1930.

A New Band System in Nitrogen

I HAVE recently directed attention in a letter which has been sent to the *Physical Review* for publication to some new nitrogen bands. Three of these bands degrading to the violet and having wavelengths 2536, 2635 and 2740 A., have been found to increase in intensity as the pressure is lowered. This is true also of the new Appleyard–van der Ziel bands recently discussed by van der Ziel, and of the new system that is reported by me in the above-mentioned letter. The three bands have been identified as (0, 1), (0, 2) and (0, 3) bands of a new system, and their frequency differences agree well with those of the lower electronic state of the Appleyard–van der Ziel bands.

Further work is in progress in an attempt to obtain bands arising on higher vibrational states. Photographs taken at lower pressure may bring out such bands.

JOSEPH KAPLAN.

University of California at Los Angeles.
Aug. 24.

Research Items

Blood-Groups of British Columbian Indians. Prof. Ruggles Gates and Dr. Geo. E. Darby have carried out an investigation of the blood-groups of the Indians of the coastal region of British Columbia (*J. R. Anthrop. Inst.*, 64, Pt. 1). Special significance seemed likely to attach to the investigation of these tribes, in view of the fact that anthropologists consider that these Indians are more Mongoloid in appearance than other American Indians, and hold that they represent a later wave of immigration from the Asiatic continent. Hence it might be expected that here would be found evidence of the *B* group characteristic in eastern Asia, which previous investigation has shown to be practically absent in the American Indian. In the event, it was found that in two individuals only among 300 tested was the *B* group found, when it was probably due to European crossing. The results of the test were : 86·7 per cent showed *O*, 12·7 showed *A* and 0·6 showed *B*. A comparison with later results taken by Dr. Darby, in company with two other observers, showed an increase to 23·6 in the *A* group ; but the earlier observations were almost confined to subjects of an older generation, while the later included a larger number of the younger. The results indicate an increase in white blood in the younger generation. An explanation is offered for the apparent disagreement of the blood-groups of the American Indian with the anthropologist's hypothesis that the Indian population of the American continent represents a relatively late migration from the north-east of Asia. The peoples of north-east Asia, through lack of isolation, have become infected with the *A* and *B* blood-groups : but the peoples of the islands and archipelagos stretching down the Asiatic coast from Saghalien to the Philippines and Borneo, and at one time possibly more widely dispersed from Tibet to the coast, have been more isolated. The blood groups of only a few have been taken at present ; but in certain instances, such as the Gilyak and the purer Ainu, they are consistent with this view.

Art and Race in India. A lecture on "Art in Orissa", delivered before the Royal Society of Arts by Rai Bahadur Ramprasad Chanda on July 25 (*Roy. Soc. Arts*, 72, Aug. 17), in describing the figure sculptures and images decorating medieval temples of Orissa, mostly on little-known sites, dwells upon certain characteristics which appear to mark a racial difference in the provinces of Indian art. In the fifth century A.D., Buddhist art reached its culmination in northern India, and Indian sculptors began to carve Brahmanic images at about the same time. The most typical of the Gupta period are three panels (*c.* A.D. 600) at Deogarh in the United Provinces. In these, while the bodies of the two principal figures incline to one another as if in conversation, the eyes and faces show that they are lost in contemplation. The same incongruity in the pose of the body and the expression of the face is even more marked in the minor figures. The Brahmanic figures of the south, however, differ widely from those of the north in spirit. They show frank participation in dramatic action with open eyes. The difference may be illustrated by comparing the Deogarh figure of Vishnu reclining under the hood of a serpent with that of a relief from Badami in the Bijapur District of the Bombay Presidency, in which Vishnu is watching with open eyes and the eyes of all the attendants are fixed upon him. Therefore we have to distinguish the Brahmanic images of the Aryan-speaking northern India and Mahārāshtra on one hand and of the Dravidian-speaking areas of the south on the other as the products of two different schools of sculpture. Fergusson long ago pointed out the differences between the Dravidian and the Indo-Aryan in architecture, and Sir John Marshall has suggested that India was indebted to the earlier Dravidian or pre-Aryan people for her natural and inborn love of ornamental design.

Hypotrochanteric Fossa in the Primate Femur. A study of the hypotrochanteric fossa in the human and anthropoid femur has been made by Dr. Aleš Hrdlička (*Smithsonian Miscell. Collect.*, 92, No. 1), in which for the first time in anatomy and anthropology it has been possible to view the whole ontogeny of a definite feature of human morphology. This study leads to the conclusion that it may be that every separate organ of the human body may have a like history of advance and either regression or other line of development, bearing on human derivations and antiquity. The hypotrochanteric fossa has some peculiar relationships. It appears in man, gorilla, chimpanzee and orang. It is not found in the old-world monkeys, but there is an occasional trace of it in the gibbon and the new-world monkeys. In the great apes it serves the definite purpose as the place of attachment for one of the large thigh muscles. It shows a progressive development in size until full growth is reached, but it is often missing in the young. In man, on the other hand, it appears in the fourth month before birth. Sometimes, however, it may appear at any stage in child and sub-adult life. It attains its greatest development before maturity, and then it begins to disappear. It may undergo its entire development and regression during childhood. While the fossa has a specific and necessary function in the ape, in man it has no function, or only a very minor one. Apparently the fossa in man and the apes is derived from a common ancestry, but while it remained an essential feature in the ape throughout life, in man, if it served any useful purpose, it was only in the early years. In early man and the precursors of man, *Pithecanthropus*, Neanderthal man, etc., the conditions do not differ substantially from those in man of to-day. The incidence of the fossa differs in various human races and other groups ; but these differences are neither great nor conformable to general racial affinities.

Incubation of Alligators. In a careful study of the egg-laying of alligators, E. A. McIlhenny found that the building of a nest, 3 ft. 9 in. high, with a 7-ft. base, occupied four days (*Copeia*, p. 80 ; 1934). On the sixth day, 34 eggs were laid in a hollow in the centre and covered with weeds and mud. A double registering thermometer was placed in the egg-mass, and daily readings showed a wonderfully stable temperature which was generally a few degrees higher than the maximum shade temperature outside, although occasionally the nest temperature was slightly lower than the outside temperature. This particular nest of eggs took sixty-six days to hatch, several days longer than the average, which is 62–64 days, but this may have been due to the daily interference

in making the thermometer readings. Another point of great interest is that the alligator which laid the eggs had been marked by McIlhenny when it hatched on August 22, 1921, so that its first nesting occurred when it was nine years and ten months old, and had reached a length of seven feet three inches.

Nephridia of *Amphioxus*. Prof. E. S. Goodrich (*Quart. J. Micro. Sci.*, 76, 499–510 and 655–674, 1934) gives an account of the development of the unpaired anterior nephridium (Hatschek's) and of the paired nephridia of *Amphioxus*. At an early stage, before the buccal diverticulum has even appeared, the rudiment of the unpaired nephridium can be first identified as one or two cells between the posterior wall of segment 2 and the anterior wall of segment 3. By the time the mouth has been pierced, the rudiment appears as a group of cells between these two segments. At first solid, it later acquires a lumen and opens into the pharynx through the endoderm. Cells grow from the blind end of this rudiment towards the cavity of segment 2, the cœlomic epithelium being now broken through. The canal of the nephridium and the solenocytes are derived from the same rudiment. At no stage could an open funnel be found. The author states that in studying the development of the paired nephridia he could find no evidence for the view of Legros that the nephridium is developed from a fold of cœlomic epithelium giving rise to the canal, open to the cœlom at first by a funnel which closes later, and that the cells of the cœlomic epithelium are converted into solenocytes. The nephridium actually arises as a group of cells between the endodermal wall of the pharynx and the cœlomic epithelium lateral thereto. The cells increase, forming a plate over which the cœlomic epithelium is stretched and then ruptured, so that the growing solenocytes formed from the more dorsal cells of the plate become exposed to the cœlomic fluid. The more ventral cells of the plate form the canal of the nephridium and remain covered by the cœlomic epithelium. The canal fuses with the dorsal wall of the gill pouch at a point where the nephridiopore comes to open. At no stage is there an internal opening. The author's conclusions are in agreement with the view that the nephridia of *Amphioxus* are true protonephridia, homologous with the protonephridia of the invertebrates, but not homologous with the excretory tubules of the Craniata, which are derived from cœlomoducts.

Systematics of Pulmonates. Mr. Henry A. Pilsbury has recently reviewed the Planorbidæ of Florida, with notes on other members of the family (*Proc. Acad. Nat. Sci. Philadelphia*, 86, 1934), and in the same volume of that journal he describes the molluscs from the Dolan West China Expedition of 1931. The first paper is a valuable contribution to the systematics of the Planorbidæ, including much that is based on the internal anatomy. It is often difficult to find differences in the shells when the animals show distinct and important specific characters. This is especially the case with the reproductive system, and many careful dissections have been made. There is a large range of variation in the Planorbidæ of Florida, and forms which by themselves would be viewed as quite distinct species seem to run together in continuous series. It is very interesting to follow the different forms of *Helisoma durgi* of the sub-genus *Seminola*, where six races recognised and described vary from a true *Planorbis* shape to a turreted shell differing only slightly from the closely related species *Helisoma scalare*. No barriers to the migration of these snails exist, so that the geographical limits of such races are only vaguely defined. In the second paper, a collection of Chinese land snails from Szechwan Province is described. Sinistral forms appear to be common in these districts, which are very rich in land molluscs.

The Termites of Java and Celebes. In *Kungl. Svenska Vetens.-akad. Handl.*, 13, 1, No. 4, 1934, Mr. N. A. Kemner contributes an important memoir on the above subject. While this work is mainly systematic in character, the biology of a number of species is also described, and their nest features are figured in the accompanying plates. The author follows recent taxonomists in regarding the Rhinotermitidæ as a separate family. As might be expected from its greater size, the island of Java with Madura has a richer termite fauna than Celebes and its neighbouring small islands. Of the new species described, 26 are from the former region and 13 from Celebes. One new genus (*Pseudocapritermes*) is described with a single species (*silvaticus*), also from Java. The work is accompanied by a full bibliography, and will prove indispensable to students of termites.

South American Potatoes. Data and material collected by Bukasov and Juzepczukii during expeditions of the Institute of Plant Industry, U.S.S.R., to Central and South America, in 1925–28, are appearing in the *Bulletin of Applied Botany, Genetics and Plant Breeding*, Leningrad. The first part, by Juzepczukii, was the "Systematics of the Potato"; the second part, by S. M. Bukasov, is entitled "The Potatoes of S. America, and their Breeding Possibilities" (*Bull. Applied Bot., Gen. and Plant Breed.*, Supp. 58. In Russian, with summary and explanations of illustrations and tables in English). The originators of the expeditions were amply justified in their belief that the home of the wild and cultivated potato had been inadequately explored. As a result of these surveys, collections and subsequent work, the primary material at the disposal of the potato breeder has been much enriched, fourteen new cultivated species, for example, having been added. The possibility of building up frost and disease resistant varieties is brought much nearer by this work; thirteen of the new species are indigenous to high mountainous regions. An interesting sidelight on the difficulties encountered in such work is the poor tuber formation and consequent loss which occurred when many samples were grown near Leningrad, where the days are long. Were it not for recent work on photoperiodism, a species like *Solanum demissum* might have received little attention there, owing to the poor tuber formation.

Sulphuric Acid Spraying against Weeds. The recognition of sulphuric acid spraying as a means of destroying surface weeds in cereal crops is rapidly becoming general, and the acreage treated in 1934 was more than five times that in 1932. The work is generally carried out by contract, as there is a natural prejudice amongst farmers against handling and diluting the strong acid preparatory to the spraying operations. Any simple means of reducing the hazards will, therefore, be welcome, and with this object in view an illustrated leaflet by R. K. Macdowall entitled "An Improved Method for the Handling and Dilution of Sulphuric Acid for Spraying

Weeds" has been issued by the Institute for Research in Agricultural Engineering (Oxford: University Press, 1*s*.). The method recommended is to prepare the spray fluid on a specific gravity basis, thereby avoiding the dilution of the acid in open tubs. The concentrated sulphuric is pumped directly into the spraying machine and mixed there 'under cover', the correct strength being adjusted by means of a hydrometer. A thorough mixing of the fluid before spraying is essential, and a hand paddle has been found to serve this purpose very efficiently. The method proved entirely satisfactory when tested out on 100 acres of corn land, and the full working details provided in this leaflet should enable many farmers to extend their spraying operations with greatly reduced risks and at the same time considerable advantage to their crops.

Electron Scattering by Atomic Electrons. A. L. Hughes and R. G. Hergensother (*Phys. Rev.*, Aug. 1) have investigated the scattering of electrons by helium under such conditions that the effect of the electrons of the helium atom was prominent. Electrons of about 1,000 volts energy were fired into helium at about 0·001 mm. pressure, and the electrons scattered at any desired angle were analysed with respect to velocity by a magnetic refocusing method, differential pumping being used to keep the pressure low in the analysing chamber. At any angle, the analysed velocities show a maximum corresponding to the elastic scattering of the electrons by the helium nucleus and a broader 'inelastic' peak which agrees approximately with the velocity $v = v_0 \cos \theta$ which would be retained by an electron of velocity v_0 after deflection through θ with another free electron. The spread in velocity of these electrons may be ascribed to the initial 'orbital' velocity of the struck electron, as in Jauncey's theory of the broadening of the Compton scattered line.

Measurement of Current in a Lightning Flash. A Mail Report from Science Service, Washington, D.C., states that since 1926, Dr. Heinrich Gruenewald and his associates of the Berlin-Charlottenburg Society for the Study of High Tension Installations have been engaged in investigating the magnitude and direction of the electric currents produced by lightning in conductors, such as the steel mast of a high tension line. The measurements were made by inserting in the path of the lightning short rods of a special substance which becomes magnetised on the passage of a current. The degree of magnetisation showed the strength of the current, and the polarity showed its direction. The largest current measured in this way was 60,000 amperes, while currents of half this value were found to be a frequent occurrence in lightning flashes. It was found that the current usually passed upward from the ground, indicating that the base of a thunder cloud is generally charged negatively.

Dissociation Constant of Boric Acid. Although boric acid and borax are important standards in the preparation of buffer solutions, the numerous determinations of the dissociation constant of boric acid are in poor agreement. A new series of values, at temperatures of 10°–50°, has been obtained by B. B. Owen (*J. Amer. Chem. Soc.*, 56, 1695; 1934) by an electromotive method. One electrode was a hydrogen electrode in a solution containing the acid, borax, and sodium or potassium chloride, and the other electrode was silver and silver chloride. Account was taken of the hydrolysis of the borax. The values of pK extrapolated to zero ionic strength, K representing the dissociation constant of metaboric acid HBO_2, or the first dissociation constant of orthoboric acid, H_3BO_3, are found to be represented by the equation $pK = 9{\cdot}023 + 8 \times 10^{-5}(76{\cdot}7 - t° \text{C.})^2$, a form known to be characteristic of a variety of weak electrolytes, although the usual factor in the temperature term is 5 instead of 8. This gives the following values of $K \times 10^{10}$:

$t°$ C.	10	15	20	25	30	35	40	45	50
$K \times 10^{10}$	4·17	4·70	5·25	5·80	6·35	6·89	7·39	7·89	8·33

At finite concentrations there will be some ambiguity owing to the formation of the ion of tetraboric acid.

Heats of Combustion of Hydrocarbons. The calorimetric heats of combustion of the saturated paraffin hydrocarbons ethane (C_2H_6), propane (C_3H_8), normal butane (C_4H_{10}) and normal pentane (C_5H_{12}) have been determined by F. D. Rossini (*Bur. Stand. J. Res.*, June 1934). The values, which are given in international kilojoules per mol for 25° C. and 1 atm. to form gaseous carbon dioxide and liquid water, are 1,559·57, 2,219·57, 2,877·88, 3,536·00, respectively, which are all about 1 per cent larger than existing values except for normal butane, for which there are no existing data. The heats of combustion of these hydrocarbons are of industrial importance, and in view of the precautions taken to ensure the purity of the materials and the accurate experimental technique, the new values are probably more correct, the differences from the existing values being 30–50 times the estimated uncertainties in the new figures. The international joule is taken as 1·00032 absolute joules and the 15° gm. cal. as 4·1850 absolute joules. The experimental method consisted in finding the amount of electrical energy which furnished heat equivalent to the heat evolved in a combustion calorimeter, the amount of reaction being determined from the mass of water formed, and small corrections were applied for a slight incompleteness in the combustion of the carbon.

Heaviside's Operational Calculus. In Oliver Heaviside's electrical work, many mathematical results were obtained by methods of his own, of which he refused to give any justification except that they worked well. "Am I to refuse to eat because I do not fully understand the mechanism of digestion?" However, the subject was placed on a logical basis by J. R. Carson and T. J. I'A. Bromwich. A good account of some modern developments is given in a 27-page tract by P. Humbert ("Le Calcul Symbolique", Paris: Hermann, 1934). Given any function, another (usually much simpler) called its *symbolic image* can be found, and to any properties of the symbolic image correspond properties of the original function. By this process, Van der Pol proved a theorem concerning Bessel functions which is very difficult to obtain by ordinary methods. Extensions have been made to differential and integro-differential equations, and to functions of two variables. In the opinion of E. T. Whitaker, we should now place the operational calculus with Poincaré's discovery of automorphic functions and Ricci's discovery of the tensor calculus as the three most important mathematical advances of the last quarter of the nineteenth century.

Association of Special Libraries and Information Bureaux

ANNUAL CONFERENCE

THE eleventh annual conference of the Association of Special Libraries and Information Bureaux held at Somerville College, Oxford, on September 21–24 presented several features of special interest to scientific workers. Sir Richard Gregory's presidential address on "Science in the Public Press" was discussed in a leading article in NATURE of September 29.

The ensuing discussion made it manifest that there is a widespread desire for reliable scientific information in a form intelligible to the general reader, and the idea of a British Science Press Service on the lines of the Science Service inaugurated in the United States in 1921 was warmly supported. The same need was expressed in a discussion on the following day on book selection. This discussion, which centred round a group of papers dealing with methods used by the Bodleian Library, contributed by Mr. S. G. Wright, by the general library, by Mr. J. E. Walker, and by the special library, by Mr. A. F. Ridley, was probably the most important technical discussion at the Conference, and the selection of scientific literature was its most prominent feature. Under present conditions, both the general library and the special library encounter much the same difficulty in the selection of reliable general and specialist books on scientific subjects, particularly foreign books, and specialist advice is not always available or as helpful as it might be. The value of some critical review of scientific books was clearly stressed and it was suggested that attempts should be made to secure the co-operation of members of A.S.L.I.B. and of the Library Association to secure the publication of such notes or reviews.

At the afternoon session on September 22, Mr. C. Nowell described the new Central Library in Manchester opened by H.M. the King on July 17, and Mr. H. F. Alexander gave an account of the new extension of the Radcliffe Science Library which is to be opened early in November.

The annual report of the Council presented to the annual meeting showed that the Association is now holding its own, although a marked increase in membership and in income is desirable if the work is to be developed adequately. A membership campaign has already been inaugurated. The report referred also to the inquiry concerning the costs of printing and publishing scientific abstracts which is proceeding and to the preparation of a "Business Man's Directory to Sources of Information" for the whole field of commerce and industry.

A feature of the conference was the admirable address on "The Idea of Planning" delivered by Major L. R. Urwick on the Saturday evening. After pointing out the dangers which attend the careless use of such words as 'rationalisation', 'scientific management' and 'planning' as a charm or panacea without reference to their real meaning, Major Urwick stressed the importance of clear thinking based on scientific knowledge in every domain of our affairs to-day. Planning is essentially an attempt to substitute censorious control for individual self-interest. It recognises no limits to human knowledge or in the organising powers of the human mind when the right principles are discovered and followed. Major Urwick thus touched on the same point of the relation of knowledge and power which was previously emphasised by Sir Richard Gregory; and he alluded to the growing influence exerted by the professional man in the management of industry, which is steadily making for direction based on technical knowledge and not political prejudice. Major Urwick stressed the necessity for a study of organisation as a technical problem as an essential part of sound planning. Planning is intimately linked with the questions of authority, control and management, and we have as yet little knowledge of what authority is required to enforce a plan if those in control are kept really informed of the factors concerned and their reactions.

Major Urwick's emphasis on the social and human elements in planning was reiterated in a later address by Mr. K. M. Lindsay, M.P., on "Public Efforts at Planning in Great Britain", in which particular stress was laid on the necessity of planning so as to preserve liberty and flexibility. The value of a public relations service as a part of the machinery of government was emphasised. The unplanned adjustments of the period 1924–34 well illustrate the fields in which planning is required, and the planning of social environment is as essential as the technical side in determining the location of new industries. Wise planning involves attention to psychological and social principles, and it is an essential condition in successful planning that it should lead to an increase in purchasing power.

As in Major Urwick's address, the field for scientific investigation which is offered here in the study of the structure of planning, if an adequate technique in which personal prejudices have been replaced by organic principles is to be developed, was again emphasised, and in particular the necessity of a pure science upon which to base the so-called applied science of market research was pointed out. On the question of information, Mr. O. W. Roskill contributed a valuable survey of the sources and supply of industrial information in Great Britain with reference to planning. Once again the necessity for a central national authority for statistics was emphasised and the necessity for much more up-to-date statistics. Frequently much time is lost in ensuring an accuracy which is of no practical value in relation to the purposes for which the figures are required when it is much more important to have the figures promptly. Users might also determine to a much larger extent the form and type in which the statistics are presented. The importance of closer co-operation between industrial organisations and university departments engaged in statistical and economic research was also emphasised, as well as the need for a different type of training for the university economist. This question of linking effectively the statistical and technical elements in industry is another special aspect of the relations between knowledge and power with which the conference was repeatedly faced, and throughout it was clear that there are many ways in which A.S.L.I.B., through its work as a clearing house of information, can contribute materially to establish those relations on a sound basis.

Currents and Fisheries of the North Sea

DURING recent years the study of marine biology has been prosecuted with great vigour by most of the maritime countries of the world, with the result that remarkable progress has been made in the elucidation of the habits and life-histories of marine organisms. Much knowledge has now been accumulated concerning those great fluctuations in the stocks of economic fishes which from time immemorial have disconcerted the fishing industries of this and every other country in which fishing activities are carried on. Such outstanding progress has in fact been made in this direction that, for some fishes at least, notably the haddock and the herring, it is now possible to make reasonably accurate forecasts concerning the magnitude of the fish stocks—and therefore of the prospects of the respective fisheries—a year or even two years in advance.

These forecasts have in the past been based largely, if not entirely, upon purely biological and biometrical studies of the fish stocks themselves and of the changes taking place within them.

But although these population fluctuations can now be followed in great detail, the question of what are the causes underlying them still remains unanswered. With the progress of marine research, however, it becomes increasingly evident that the further elucidation of this problem must be sought in a more intensive study of the environment—that is to say, of the physical and chemical properties of the sea itself.

Now one of the most outstanding and most important characteristics of the sea is its constant and more or less complex motion. It is particularly noteworthy, therefore, that the entire afternoon session of Tuesday, September 11, was devoted by Section D (Zoology) of the British Association at Aberdeen, to a very full discussion of "The Currents of the Sea and their Biological Importance" in which the following took part: Dr. J. B. Tait, Fishery Board Laboratory, Aberdeen; Dr. J. N. Carruthers, Fisheries Laboratory, Lowestoft; Prof. A. C. Hardy, University College, Hull; and Dr. E. R. Gunther, of the scientific staff of the "Discovery" Committee. In the course of this discussion, it was pointed out that, from the biological point of view of the environmental relationship of fishes, the importance of the sea's constant movement lies in the fact that the physical conditions of almost every region are thereby subject to continuous change. Moreover, fishes are dependent upon certain movements in the sea for the conveyance of much of their food to the regions they inhabit. These same movements further control the passive migrations of the eggs of most fishes and of their young stages before their swimming powers have developed. The movements of the sea have thus a double effect from the biological point of view, first because of their purely mechanical effects and secondly as governing the physical and chemical conditions of any given region. In both these respects, it is the horizontal movements or currents, especially those of the upper water layers, which are generally of most importance; although Dr. Gunther pointed out that in some regions at least—notably on the west coast of South America—*vertical* currents are of fundamental biological importance.

The measurement of horizontal currents in the sea presents numerous practical difficulties. In the northern North Sea these difficulties have been mainly overcome by the use of drift-bottles of suitable design. Recent analyses of elaborate drift-bottle experiments confirm the presence of extensive drift-currents in the northern North Sea. These currents can, and do, often possess chemical and physical properties very different from those of the adjacent waters on either side. Such great variations in the properties of the water as are occasionally noted within a short interval of time at the same hydrographical station may therefore well be due to alteration in the direction of flow of a stream current and not, as is usually implied, to such radical hydrographical changes as betoken large and rapid hydrodynamical variations; for it can be taken as a general rule that modifications in the physical phenomena of the sea in which time is an essential factor do not take place with marked suddenness. The drift-bottle and hydrographical records further show that the main stream current affecting the northern North Sea is that which brings in Atlantic water around the north of Shetland through the Faroë-Shetland Channel.

In the southern North Sea, the hydrographical conditions are governed largely by the flow of water through the Straits of Dover. By means of a current meter attached to the Varne Lightship, data concerning the strength and direction of this current have been collected continuously over the last eight years. The varying water movements observed, when balanced out over a term of years, have effected the same overall transport of water as would have been accomplished by a very slow river flowing at the rate of about 3·2 miles a day from the English Channel into the North Sea. In certain circumstances the current flows the other way. Following winds quicken it and head winds impede it. A play of such wind conditions over the North Sea at large, as would be expected to pool up the Southern Bight (and north-westerly wind conditions are well known to do this), can most effectively hold up and reverse the current.

The results of the last three years are of especial interest, for, instead of the residual current heading boldly into the North Sea (as it most frequently had done in the previous three years) it has displayed less and less easting with the passage of time. During 1933, the current headed about half a point west of north.

Such long-enduring modifications of the current are held to be analogous in a way to the short-lived modifications produced by wind influence. The inferred cause, in their case, however, is an oceanic pulse—an accession of strength on the part of the parent supply stream which flows in from the ocean round the north of Scotland. This causes an extra strong southward urge of waters through the North Sea—with the results observed in 1933 particularly.

The Dover Straits current attains its strongest and weakest rates of flow a half year later than does the current entering the North Sea round the north of Scotland, but a quarter year later than the current in the Cromer Knoll region.

These facts are interpreted to indicate that the Dover Straits current waxes and wanes through the year in a sort of buffer relationship with the current from the North—that there exists a sort of seesaw conflict between the two. The vagaries of the Dover Straits currents are, on the strength of the findings mentioned, held to serve as pointers to

major modifications of the currents in the northern and middle reaches of the North Sea half a year earlier.

The results obtained from the current measurements in question have been applied to various problems of fishery interest. Amongst those of immediate local concern, that is, germane to the southern North Sea, there are the questions of good and bad survival years for the plaice and for the herring of the great East Anglian autumn fishery. The latter originate from vast annual spawnings in the eastern end of the Channel. It seems that good fortune has attended the broods of both fish when, during the egg and/or fry stages, the current issuing from Dover Straits has been most average in point both of strength and direction. This accords with the supposition that good augury for a plaice brood exists when the products of the spawning are transported to the Continental coastal shallows—the so-called young plaice nursery grounds.

Other problems calling for the application of the Varne lightvessel current data in their local rôle are concerned with the intermingling of two types of herring through the Straits, and with the outcome of the Belgian spent herring fishery. This latter is carried out upon fish supposedly enfeebled by the operation of spawning in the eastern channel.

Applied at a distance as it were, on the strength of the facts set out above, the Dover Straits current data enable something to be said about good and poor haddock years. The haddock fluctuates very closely (though oppositely) with the herring, and seems, when in the egg and fry stage, to have experienced the best survival conditions when we should judge the waters to have been most strongly urged towards the south.

The year-class fluctuations of the cod have been studied side by side with meteorological data, and it appears that the best augury for a brood obtains in those spawning seasons during which winds from the half-compass centred on north-east have been at a maximum—a finding which accords well with what is inferred in the case of the haddock from the Varne current data. G. A. S.

Translocation in the Cotton Plant

THE cotton plant continues to be a fruitful source of information regarding the movement of materials in plants. Phillis and Mason[1], in a paper which deals more particularly with the transport of carbohydrate out of the leaves into the vascular tissue, have re-examined the evidence which led Mason and Maskell[2] to the conclusion that carbohydrate was exported from the mesophyll as reducing sugar and condensed to sucrose in the phloem of the transporting tissue, and that carbohydrate is translocated in the form of sucrose along concentration gradients in the phloem.

The results of Phillis and Mason, derived from an elaborate series of ringing experiments and determinations of diurnal fluctuations in the concentration of sugars in the lamina and petiole, indicate that sucrose, and not reducing sugar, is the form in which carbohydrate is moved from the mesophyll to the veins as well as longitudinally down the petiolar phloem. They find further that the concentration of sucrose is greater in the vein and petiole than in the mesophyll, suggesting that sucrose is accumulated against a concentration gradient. By subdividing the petiole into wood and inner and outer bark, they concluded that this accumulation occurred in the phloem region, and an examination of the distribution of sieve-tubes and companion cells indicated the localisation of the process in the large companion cells and undivided phloem mother cells of the fine veins. These 'transition cells' thus remove sucrose from the leaf parenchyma and liberate it to the sieve tubes of the veins, whence it is transported by a diffusion process down concentration gradients. The problem of translocation is thus further complicated by the additional problem of accumulation against a concentration gradient, a mechanism which is far from being completely understood even in the case of much simpler substances than sucrose.

No. 5 of the Memoirs of the Cotton Research Station, Trinidad, 1934, contains two further papers by Mason and Maskell. The first[3] deals with the transport of phosphorus, potassium, calcium and nitrogen. The results indicate that these elements move upward in the xylem, and with the exception of calcium, are re-exported from the leaf and move downwards in the phloem. Estimations of the ratios of nitrogen, phosphorus and potassium to carbohydrate moving downwards from the leaves indicate that these elements are probably in excess of the amounts required for growth of the lower tissues. It is suggested that mineral elements ascend the stem from the roots with the transpiration current, passing with the bulk of the water to the leaves, where accumulation occurs together with the synthesis of organic compounds. Downward movement of these mineral substances is accompanied by leakage laterally, not only to the growing and storage tissues but also into the tracheæ, in which they may be moved upward again by the transpiration stream. Calcium was not appreciably re-exported from the leaf and seems incapable of moving in the phloem, facts which the authors suggest may be correlated with the combination of this element with cell contents, or the relative impermeability of the cell membranes.

The other paper[4] consists of the examination of changes in the concentrations and vertical gradients of mineral elements and carbohydrates in relation to ontogeny, the object being to derive evidence to show whether transport occurs by a diffusion mechanism determined by individual concentration gradients for each substance moved or by "a mass flow of sap containing all the mobile materials" from a region of higher to one of lower turgor pressure. Negative gradients from the foliage region downwards were found for nitrogen, phosphorus, potassium and calcium, but it is suggested that the "dynamic gradient of mobile material was being masked by a static gradient of storage or immobile material".

In the case of nitrogen, a positive gradient of residual nitrogen is shown to be almost completely masked by the storage of asparagine, which results in a steep negative gradient of crystalloid nitrogen. Except in the case of potassium, the evidence for

positive gradients of the mineral elements is not conclusive, the ontogeny showing storage of calcium, initial storage of phosphorus followed by depletion, and no storage of potassium. The gradients are consequently negative in the two former cases and positive for potassium. The observed positive gradient of total osmotic pressure in the bark would seem to lend support either to a diffusion or a mass flow mechanism. The authors claim, however, that the data in general support the view that "movement of materials along the phloem is determined independently for each material by the concentration gradient of its mobile form in the channel of transport". W. E. B.

[1] *Ann. Bot.*, **47**, 585; 1933.
[2] *Ann. Bot.*, **42**, 189; 1928. **42**, 571; 1928.
[3] *Ann. Bot.*, **45**, 125; 1931.
[4] *Ann. Bot.*, **48**, 119; 1934.

University and Educational Intelligence

WALES.—The Council of University College, Cardiff, has made the following appointments: Mr. E. E. Edwards, adviser in agricultural zoology; Dr. Dorothy Strangeways, assistant lecturer in histology; Dr. R. W. Haines, assistant lecturer in anatomy; Mr. C. W. Startup, assistant lecturer in physiology.

The Council has awarded the Dr. Price prize in anatomy to Mr. Henry Vernon Jones.

CHARLES W. ELIOT, the Harvard president who did so much during his forty years of office to make his University famous, has been the subject of many addresses and articles commemorating his birth a hundred years ago. One of these, by the present head of the University, Dr. J. B. Conant, published in *School and Society* of April 7, emphasises the unusual combination exhibited in his character of rigid principles and invincible faith and courage with a power of mental growth persisting through a great part of his career. This power was exemplified in the reshaping of his original conception of the function of a university as primarily "regular and assiduous class teaching". Influenced in part by the ideas which guided his friend Gilman in inaugurating advanced study and research work at Johns Hopkins University in 1876, he came to recognise graduate work as essential to the idea of a university. There is an element of irony in the juxtaposition in another issue of the same journal of a quotation from one of Eliot's latest pronouncements on education and a paper read before the Association of American Universities at its last annual conference on the "alarming growth" of graduate work in institutions not designed and equipped for it and in many instances not even fully qualified for work of the college grade. It appears that some 20,000 awards of the master's degree are now made annually and it becomes increasingly difficult to protect even the Ph.D. against inflation. Recent investigations show that, without counting teacher-training departments of universities, there are 233 graduate schools, of which no more than 27 have been deemed eligible to membership of the Association of American Universities, while, to make matters worse, additional institutions of undergraduate calibre are constantly breaking into the graduate field, and the aggregate enrolment in these pseudo-graduate schools, some of which have the effrontery to offer a doctorate, is mounting at an amazing rate.

Science News a Century Ago

Halley's Comet

A century ago, much interest was shown in the approaching reappearance of Halley's comet, which had last been seen in 1759. Damoiseau in Italy, Pontecoulant in France and Lehmann and Rosenberger in Germany had all made calculations regarding it, and had shown that it would be visible again in the latter part of 1835. An American paper, however—the *New York Commercial Advertiser*—announced in the late summer of 1834 that Halley's comet was visible in the east, near the constellation Taurus, and that its distance from the earth was 40,000,000 miles. It also said that on September 13 the comet would be only 22,000,000 miles distant and that on October 6 it would be nearest the earth, being then only three and a half million miles distant. The announcement was reprinted in the *Times* of October 6, 1834, and it was followed a few days later by a note from an Irish paper in which a correspondent pointed out that the comet would not be seen until a year later. As a matter of fact, the comet was first observed from the Jesuit Observatory in Rome on August 5, 1835.

Invention of a Sphygmometer

In the *Times* of October 6, 1834, it is recorded that at a meeting of the Paris Academy of Sciences, Dr. Magendie made a report upon an instrument invented by Dr. Hérisson called the 'sphygonemètre' which shows the rate of the pulse, its rhythms and anomalies. In pursuance of the conclusion of the reporter, the Academy passed a vote of thanks to the author of this most useful and ingenious discovery. Dr. Hérisson published a memoir, showing the results of his several applications of this instrument in studying the diseases of the heart. After six years of clinical researches supported by numerous anatomical proofs, he claimed that it was capable of distinguishing organic affections from cases which only assume the appearance of such affections. As the sphygmometer gave the numerical force of the pulse, it was possible, according to the observations of Dr. Hérisson, to prevent such attacks of apoplexy as arise from a too great determination of the blood towards the head.

The Dublin and Kingstown Railway

The first railway in Ireland was that from Dublin to Kingstown constructed by C. B. Vignoles (1793–1875) and the first train ran on October 9, 1834. The following comments are from *Saunder's Dublin News Letter* (Oct. 10, 1834). "Yesterday, Oct. 9, a train of carriages proceeded for the first time from the station house at Westland Row to Salt-hill. A great number of ladies and gentlemen, invited by the directors, enjoyed this so novel a treat in this country." Two trips were made, the train being drawn in the first instance by the locomotive *Hibernia* built by Sharp, Roberts and Co., of Manchester, and in the second by the locomotive *Vauxhall* built by Messrs. Forester and Co., of the Vauxhall Foundry, Liverpool. Among other remarks it was said that, "nothing could surpass the admirable manner in which the spiral springs which are attached to the buffers ward off the concussion when the train is stopped. . . . Every person who joined in the trip was delighted with the perfect ease to themselves.

. . . We sincerely trust the general completion of the works will admit our fellow citizens at large to enjoy the pleasure of a steam trip such as we have had yesterday. All apprehensions of fear will soon vanish, when they experience the great comfort and accommodation with which railway conveyances will present them." The line was officially opened on December 17, 1834.

The Zoological Gardens

On October 11, 1834, the *Times* announced that "The Zoological Society have succeeded in obtaining a most abundant supply of water at the depth of 192 feet from the surface. The well was sunk 184 feet, and at a further depth of 8 feet, which was effected by boring, the water came in so rapidly as to rise 26 feet in 20 minutes in a well of 9 feet diameter. This water will be distributed over their beautiful gardens by means of a steam engine, and thus an additional attraction added to this amusing and fashionable resort. The Society will by these means be delivered from the West Middlesex Waterworks Company to whom they have formerly paid 200£ per annum, but who have demanded and received for the last quarter the sum of 250£, or at the rate of 1000£ per annum."

Rare Orchid in Bloom

Among the most interesting accounts in the 1835 volume of *Curtis' Botanical Magazine* is the description of Deppe's *Maxillaria*, which first flowered in Earl Fitzwilliam's orchid house in October 1834. This orchid, *Maxillaria Deppii*, was received from Mr. Deppe, who gathered it in New Spain, the description relates, and it first flowered under the care of James Cooper, the well-known orchid expert of Wentworth Gardens. Another flowering of October 1834 at Wentworth Gardens, described in the same issue of the *Botanical Magazine*, was that of the halberd-leaved clerodendron, *Clerodendron hastatum*, one of the Verbenaceæ. This vervain was introduced into Great Britain from the Botanical Gardens of Calcutta by Dr. Wallich. It was first discovered by Mr. Smith, the collector, at Sylhet, and he sent it to Dr. Roxburgh in 1811. The clerodendrons, however, were climbers that became increasingly cultivated in the latter half of the last century, and thirty years later, *Clerodendron Balfouri* was widely cultivated, doing fairly well when trained on low walls in light sunny positions, grown in pots and well pruned annually. An issue of "The Garden" for 1878 described this species as blooming freely in a London garden.

Societies and Academies

PARIS

Academy of Sciences, August 20 (*C.R.*, **199**, 469–500). MAURICE D'OCAGNE: An indeterminate equation of any order whatever. CAMILLE GUTTON, JEAN GALLE and HENRI JOIGNY: The reflection of radio waves in the upper atmosphere. GEORGES GIRAUD: New results relating to principal integrals of any order. GH. TH. GHEORGHIU: Metaspherical functions. MLLE. M. PERNOT: The system mercuric chloride, potassium chloride and ethyl alcohol. VASILESCO KARPEN: The passage of current in electrolytes without electrolysis. A solution of iodine in aqueous potassium iodide permits the passage of a permanent current without electrolysis: the concentration of iodine is increased at the anode and diminished at the cathode. RAYMOND QUELET: A new method of synthesis of the alkoxy(α-hydroxyethyl)benzenes and the corresponding ether oxides. P. LAVIALLE and P. JAEGER: The cytology and nuclear peculiarities of the pollen grain of the Dipsaceæ. HENRI HERMANN, GEORGES MORIN and JOANNY VIAL: Modifications of arterial pressure in the course of, and after, the progressive destruction of the spinal marrow in the dog. GEORGES BOURGUIGNON: The variation of the chronaxy of a muscle during the voluntary contraction of its antagonistic muscles in normal man. ROBERT RANJARD: Contribution to the physiology of the development of hearing by the fundamental sounds of the vowels. MARCEL BAUDOUIN: A very rare double monstrosity, a thoradelph cat. TCHIJEVSKY and VOYNARD: The ageing of the organism retarded by the inspiration of negatively ionised air.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 5). P. S. NOVIKOV: On a property of analytic complexes. A. A. LIAPUNOV: The separability of analytic complexes. N. N. LUZIN: Some notes on multiple separability. A. G. ANJOUR: A new type of movement of a solid body which can be squared. M. S. EIGENSON: The central forces of attraction and repulsion in a gravitational problem of two bodies of variable mass. A. I. SERBINOV and M. B. NEUMAN: The effect of nitrogen peroxide on the kinetics of ethane oxidation. The velocity of oxidation is increased several times by adding small quantities of NO_2 to the mixture. The probability that this is due to a selective transfer of energy from NO_2 molecules to O_2 or C_2H_6 is discussed on theoretical grounds. M. V. KRAUSE, M. S. NEMCOV and E. A. SOSKINA: The kinetics of ethylene polymerisation. M. E. LOBASHEV and F. A. SMIRNOV: The nature of the action of chemical agents on mutation in *Drosophila melanogaster* (1). The action of acetic acid on non-disjunction and translocation. B. V. KEDROVSKII: New data on the morphology of protein metabolism in a living cell. R. I. BELKIN: The influence of the substance of the posterior lobe of the hypophysis on regeneration in axolotls. A. I. POTAPOV: Plant growth in subtropical soil as a function of mineral nutrition. Aluminium in the soils of humid subtropics is often toxic to plants, but this effect can be neutralised by introducing large quantities of superphosphate. N. V. NASONOV: Structures produced in the axolotl by the subcutaneous insertion of a desiccated regeneration bud. I. I. SCHMALHAUSEN: On the phenogenetics of some morphological characters in poultry.

SYDNEY

Royal Society of New South Wales, June 6. A. R. PENFOLD, G. R. RAMAGE and J. L. SIMONSEN: The identity of darwinol with d-myrtenol. The authors show that the alcohol, darwinol (*J. Proc. Roy. Soc. N.S.W.*, **57**, 237; 1923. **60**, 8 and 331; 1926) is identical with myrtenol, isolated by Semmler (*Ber.*, **40**, 1363; 1907) from myrtle oil. The identity of the alcohols was confirmed by the preparation of the acid phthalate, m.pt, 111°–112°, phenylurethane, 58°–59°, and α-naphthylurethane, 92°–93°.

VIENNA

Academy of Sciences, June 28. J. KISSER and L. PORTHEIM: Experiments on the applicability of hydrogen peroxide to the treatment of seed. Certain seeds, but not all, can be completely disinfected without injury to their germinating properties, by treatment with 30 per cent hydrogen peroxide solution. JOVAN JURIŠIĆ: The gland-hairs on the roots of *Bryophyllum*. ROBERT JANOSCHEK: The age of the Moldavite scree in Moravia. KARL JEŽEK: Supporting power of a column of an ideal plastic steel. HERMANN WENDELIN: The *R*-integrability of compound functions, and a generalisation of a law of H. B. Fine. EDGAR SCHALLY: Results of experiments undertaken to establish the cause of *D*-streaming. This streaming must be attributed mainly to diffusion processes. ADOLF BACHOFEN: Occurrence of *Megaceros* in historical time. Evidence is advanced to show that *Megaceros* occurred about 500 B.C. in the steppes of South Russia or in the Caucasus. E. HEINRICHER: The greening of *Primula* blooms. HERMANN TERTSCH: Directed abrasion tests.

July 5. PAUL LUDWIK and JOSEF KRYSTOF: Determination of the tensile strength of cast-iron by the wedge-pressure test. STEFAN MEYER: Relation between the initial velocity and range of α-particles. ELISABETH KARA-MICHAILOVA and HANS PETTERSSON: Experiments on the detection of a γ-radiation from excited xenon nuclei. With a Geiger-Müller tube it has not been found possible to detect γ-radiation from xenon irradiated with polonium α-particles. FRIEDRICH HERNEGGER: Direct determination of the degradation constant of ionium from the number of α-particles emitted. By this means the following values are found for the radioactive constants of ionium: $\lambda = 8{\cdot}096 \times 10^{-6}\, a^{-1} \pm 1{\cdot}0$ per cent, $t = 124{,}000$ years, $T = 85{,}600$ years. BERTA KARLIK and HANS PETTERSSON: The spectrum of polonium. A method of investigating the optical spectra of difficultly volatile substances in highly-heated quartz spectrum tubes, excited with short waves, is described. Using platinum foil coated with polonium, two intense lines at 2450 and 2558·1 A., and a questionable one at 3005 A., were observed. HANS PETTERSSON and JOSEF SCHINTLMEISTER: Atomic fragments of short range from heavy noble gases. MARIETTA BLAU and HERTHA WAMBACHER: Experiments, by the photographic method, on the disintegration of the aluminium nucleus. GUSTAV ORTNER and JOSEF SCHINTLMEISTER: Radioactivity of samarium. GEORG WALTER and ERNST STORFER: Complex metallic salts of thio-urea (2, 3 and 4). GEORG WALTER, MAX ADLER and GEORG REIMER: Complex metallic salts of thio-urea (5): Electrochemical behaviour. ERNST BEUTEL and ARTUR KUTZELNIGG: Colorations appearing in the systems cupric chloride-halogen hydracid-water-alcohol (ether, aldehyde, ketone, acid, ester). GEORG KOLLER and ADOLF KLEIN: Saxatilic acid. This acid, from *Parmelia saxatilis*, is identical with the salazinic acid of Asahina. ATMA MALABOTTI: Transformations of insects (*Tenebris molitor*, L., *Vanessa io*, L. and *V. urticae*, L., *Dixippus morosus*, Br. et Redt.) with replanted heads. W. SCHMIDT: Temperature measurements of 17 Austrian Alpine lakes during 12 months. HANNS TOLLNER, with F. KOPF: Measurements of the nocturnal radiation of heat during the polar night 1932–33 on the island of Jan Mayen. The radiation Q and the extent of cloud B, expressed as a decimal of the surface of the sky, are connected by the simple relation, $Q = 0{\cdot}08 - 0{\cdot}006\, B$. The total loss of heat from the island during the three months December–February corresponded with a loss of 4·8 Cal. per sq. cm. per minute. KASIMIR GRAFF: The visual colour law of the Præsepe stars. W. E. BERNHEIMER and J. P. REIMER: Investigation of the galactic star cluster N.G.C. 2632 (Præsepe). ROBERT SCHWINNER: Geology of Eastern Styria (2): structure of the mountains north of Birkfeld. PAUL SOLOMONICA: The border region between Flysch and Kalkalpen from Traisen to Mank. F. E. SUESS: Comparative orogenetic studies. MAX PESTEMER: Ultra-violet absorption of binary liquid mixtures (5). The system acetone-hexane. MAX PESTEMER and OTTO GÜBITZ: Ultra-violet absorption of certain aromatic hydrocarbons (2). Mono-*n*-alkylbenzenes. K. W. F. KOHLRAUSCH and A. PONGRATZ: The Raman effect (36). Raman spectrum of polysubstituted benzenes. FRANZ KAHLER: (1) Occurrence of fusulinides in the Carbonaceous and Permian of the Carinthian Alps; (2) Comparison of the American and Carinthian stratigraphy of the Carbonaceous and Permian with the help of *Fusulina* species. K. HÖFLER: Specific permeability series. Experiments on the permeability of the cells of various plants to different substances are described.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 323–402, June 15, 1934). FREDERICK D. ROSSINI: The energies of the atomic linkages in the normal paraffin hydrocarbons. The latest data on the heats of combustion indicate that the energy of dissociation of gaseous molecules of C_nH_{2n+2} into gaseous carbon and hydrogen atoms is a linear function of n when $n > 6$. Deviations are in the direction of increased stability of the molecule, suggesting that the various C–H and C–C bonds are not alike. J. D. H. DONNAY and J. MÉLON: Ammonium and potassium molybdotellurates, two homeomorphous orthorhombic substances. LINUS PAULING and L. O. BROCKWAY: The structure of the carboxyl group (1). The investigation of formic acid by the diffraction of electrons. Resonance of the double bond between the two oxygen atoms has been verified; and in the double molecule the two parts are joined together by hydrogen bonds between the oxygen atoms of the carboxyl group. LINUS PAULING and J. SHERMAN: The structure of the carboxyl group (2). The crystal structure of basic beryllium acetate. It is concluded that the molecule contains four BeO_4 tetrahedra with one common corner; the remaining corners being occupied by oxygen atoms of the acetate groups. The distance Be–O is 1·65 A. X-ray data are used, with assumptions as to certain atomic distances. E. T. ALLEN: Neglected factors in the development of thermal springs. All seem to be due to the same fundamental causes: circulating ground water, heated by magmatic steam, deriving mineral matter from adjacent rock and magmatic sources. The great differences in individual springs are due to local causes; for example, character of outlet channel of a bicarbonate spring determines whether carbon dioxide is readily liberated and hence the deposition of travertine. In absence of limestone, topography, by control of depth to which water sinks, determines type of spring. CHESTER STOCK: Microsyopsinæ and Hyopsodontidæ in the

Sespe Upper Eocene, California. M. DEMEREC: Biological action of small deficiencies of X-chromosome of *Drosophila melanogaster*. Deficiencies were generally induced by X-rays and in most cases it was found that the regions affected are cell-lethal, as shown by the absence, in homozygous conditions, of the mosaic spots used for testing. CHAS. B. DAVENPORT: Ontogeny and phylogeny of man's appendages. The human fœtus starts with an intermembral index (arm-length/leg-length) like that of the young of the gibbon or chimpanzee and is gradually changing to the form of the relatively short-armed man during intra-uterine life. The human brachial index (lower arm/upper arm) shows a sharp break at birth whereby the lower arm falls behind in relative length until adolescence; during prenatal life it follows the general primate trend, deviating from plan more and more from birth onwards. E. M. EAST: The reaction of the stigmatic tissue against pollen-tube growth in selfed self-sterile plants. Seeds are sometimes obtained from such plants, by pollination in the flower buds before opening, and also at the end of the flowering season. Growth curves of pollen-tubes suggest the presence in the stigmatic tissue of the mature flower of substances which check pollen-tube growth. They appear normally just before the flower opens, while at the end of the flowering season they may fail to appear through lack of nutrient. The growth curves of pollen-tubes in bud fertilisation are peculiar in that they show no accumulation of depressive factors. EINAR HILLE and J. D. TAMARKIN: On the summability of Fourier series (5). G. A. MILLER: Groups of order 2^n whose squared elements constitute a cyclic subgroup. J. L. DOOB: Stochastic processes and statistics. RICHARD C. TOLMAN: Remarks on the possible failure of energy conservation. The continuous β-ray spectrum emitted in natural radioactive processes seems to be such a case for an individual elementary process. Statistical conservation is not necessarily violated, assuming that nuclei have a finite probability of forming only when the total energy available is equal to the average energy which will be made available by their later decomposition. A. H. TAUB, O. VEBLEN and J. VON NEUMANN: The Dirac equation in projective relativity. FRANCIS G. BENEDICT and HOWARD F. ROOT: The potentialities of extreme old age. A general statement of some of the physiological and psychological attributes of old age, with special reference to a Mr. Seth W. Lincoln, of Worcester, Mass., aged ninety-one years. JAMES BONNER: Studies on the growth hormone of plants. (5) The relation of cell elongation to cell wall formation. Sections about 3·7 mm. long cut from behind the tip of oat coleoptiles and placed in growth substance solution show that elongation is not necessarily accompanied by corresponding wall formation (cellulose); at 2° C. practically no new wall is laid down, while with addition of fructose more than normal is formed. FRANCIS B. SUMNER: A test of the possible effects of visual stimuli upon the hair colour of mammals. In view of the susceptibility of fishes and amphibia to colour changes of surroundings due to chromatophore changes, the author thought it worth while to consider the possibility that colour changes in higher animals might be related to some similar causes. Mice of known origin were reared and bred in coloured cages, but no evidence of any change of coat colour was obtained. The experiment was of short duration and the material was not treated statistically.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 8

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt. Guy Dollman: "The Evolution of the Horse".

Tuesday, October 9

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. G. Gamow: "The Recent Development of Nuclear Physics and its Astrophysical Applications" (succeeding lectures on October 12 and 16)*.

Friday, October 12

SCHOOL NATURE STUDY UNION, at 6.—(at the Institute of Education, Southampton Row, London, W.C.1. In conjunction with the London School Gardening Association).—Dr. Hugh Nicol: "The Microbes in your Soil".

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Irish Academy. Vol. 42, Section A. 1: The Wave-Equation corresponding to a given Hamiltonian. By P. G. Gormley. 2: On the Stability and Oscillations of Certain Permanent Arrangements of Parallel Vortices. By W. B. Morton. Pp. 14. Vol. 42, Section B, No. 4: Further Contributions to the Fungus Flora of Ulster. By A. E. Muskett, H. Cairns and E. N. Carrothers. Pp. 41–54. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1571 (Strut. 139): Distortion of a Stripped Two-Spar Metal Wing under Torsional Loading. By D. Williams and H. F. Vessey. Pp. 17+12 plates. 1*s*. net. No. 1583 (S. and C. 561): Wind Tunnel Tests on Junker Type Ailerons. By F. B. Bradfield and W. E. Wood. Pp. 6+7 plates. 6*d*. net. No. 1586 (Strut. 111B): Stressing of a Fuselage under combined Bending and Torsion. By A. G. Pugsley. Pp. 11+2 plates. 9*d*. net. (London: H.M. Stationery Office.)

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 53: Metallurgical Abstracts and Index to Volumes 51, 52 and 53 of the Journal. Pp. v+887. 80*s*. net, inclusive of 2 preceding "Proceedings" vols. Vol. 54. Edited by G. Shaw Scott. Pp. 326+22 plates. 31*s*. 6*d*. net. (London: Institute of Metals.)

Brighton Technical College. Calendar, Session 1934–35. Pp. 115+8 plates. (Brighton.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1581 (G. 33, 65): Stresses in the Fuselage induced by Gusts. By H. R. Fisher. Pp. 18+6 plates. 1*s*. net. No. 1589 (T. 3489): A Modified Chattock Gauge of High Sensitivity. By V. M. Falkner. Pp. 7+1 plate. 6*d*. net. No. 1592 (T. 3498): Heavy Flexible Cable for Towing a Heavy Body below an Aeroplane. By H. Glauert. Pp. 8+9 plates. 1*s*. net. (London: H.M. Stationery Office.)

OTHER COUNTRIES

U.S. Department of Agriculture. Circular No. 317: Protection of Orchard and Shade Trees and Ornamental Shrubs from Injury by the Japanese Beetle. By W. E. Fleming, F. W. Metzger and M. R. Osburn. Pp. 8. 5 cents. Miscellaneous Publication No. 201: Traps for the Japanese Beetle, and how to use Them. By F. W. Metzger. Pp. 12. 5 cents. (Washington, D.C.: Government Printing Office.)

Cornell University: Agricultural Experiment Station. Memoir 154: A Study of some Ecological Factors influencing Seed-Stalk Development in Beets (*Beta vulgaris* L.). By Emil Chroboczek. Pp. 84. Memoir 155: Studies in the Biology of *Phytophthora infestans* (Mont.) de Barry. By Willard Crosier. Pp. 40. Memoir 156: Relation of Nitrate Nitrogen to the Carbohydrate and Nitrogen Content of Onions. By A. L. Wilson. Pp. 30. (Ithaca, N.Y.)

Smithsonian Miscellaneous Collections. Vol. 92, No. 1: The Hypotrochanteric Fossa of the Femur. By Aleš Hrdlička. (Publication 3250.) Pp. ii+49+14 plates. Vol. 92, No. 2: New Fresh-Water Mollusks from Northern Asia. By Alan Mozley. Pp. ii+7+1 plate. Vol. 92, No. 3: Lethal Response of the Alga *Chlorella vulgaris* to Ultraviolet Rays. By Florence E. Meier. Pp. ii+12+3 plates. Vol. 92, No. 8: Samuel Pierpont Langley. By C. G. Abbot. Pp. ii+57+6 plates. (Washington, D.C.: Smithsonian Institution.)

Ministry of Finance, Egypt: Survey of Egypt. Geology of Egypt. Vol. 2: The Fundamental Pre-Cambrian Rocks of Egypt and the Sudan: their Distribution, Age and Character. Part 1: The Metamorphic Rocks. By Dr. W. F. Hume. Pp. lxv+300+124+96 plates. (Cairo: Government Press.) 300 P.T.

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No. 3389 Vol. 134

CONTENTS

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Industrial and Social Interactions

IN many of the addresses and discussions at the recent meeting of the British Association at Aberdeen, attention was given to the social and economic problems which have arisen out of the greater command of Nature placed in the hands of man by the creative ingenuity of the engineer. The advent of power production has resulted in a profound change in the character of industry, and for this reason alone scientific workers, using the term in the broadest sense, should be rightly concerned with the social consequences of scientific discovery and invention. This approach from the engineering or mechanical side, and particularly the endeavour to assess the contribution of what has been termed the engineering mind to questions of distribution and consumption as it has been applied in the field of production, tends to obscure the fact that the attention of science has been focused on social questions with almost equal power from a very different point of view.

The scientific study of the human problems of industry may be said to have commenced with the post-War period. The initial stimulus was undoubtedly derived from the success of the inquiries carried out in 1915–17 by the Health of Munition Workers Committee. The original conception of industrial fatigue was largely that of a rather simple and special study prompted by an acute national emergency. The various reports issued by the Industrial Health Research Board or the publications of the National Institute of Industrial Psychology well illustrate how the work, which began as a clearly defined problem in the supply of munitions, continued as a complex and changing study of profound importance to all industry. The committees associated with the Industrial Health Research Board cover statistics, physiology of muscular work, industrial psychology, heating and ventilation, industrial pulmonary disease, physiology of hearing, physiology of vision; and the reports of the Board range freely over these subjects, industrial accidents, vocational guidance and selection, and the like.

The work has, however, now extended far beyond laboratory investigations, and a recent admirable study by Prof. E. Mayo, "The Human Problems of an Industrial Civilisation" (New York: The Macmillan Company, 1933), illustrates the point that it can, and is, playing its part in bringing before the scientific world some

of the larger social issues. It is not merely that there is no simple condition or fact described by the word 'fatigue', for example, and that fatigue is rather a convenient word to describe a variety of phenomena. The disuse of the word 'fatigue' in the title of the Industrial Health Research Board tokens indeed a significant admission that the problems are highly complex and that the industrial investigator must take account of many factors, some of which may lie outside the boundaries of industry proper. Investigations have revealed the existence in the works situation of difficulties and disabilities which are the direct outcome of external conditions, and can scarcely be removed by methods developed inside the works.

The question of industrial *moral* in this way becomes related directly to that of public *moral*. It is not enough to have an enlightened company policy in all staff matters and a well-planned programme of manufacture with adequate scientific and technical control, if effective human collaboration cannot be secured. Account must be taken of the real difficulties experienced by the workers in their social, as well as in their industrial, environment.

The focusing of attention on social conditions from this point of view of industrial efficiency and welfare reveals at once that some of the difficulties experienced by industry in regard to *moral* are due to the reaction of the disintegrating influence of industry itself on the social order. Changes in social habits induced by industrial demands or development, or the greater freedom conferred by new methods of communication or transport, frequently tend to diminish social control and the social understanding and support which the ordinary individual requires. Such conditions demand an accession of intelligent self-control, just when many find it difficult to formulate for themselves new attitudes or habits.

In the social disorganisation thus created—this breakdown of the social codes which formerly disciplined us to effective working together—we find the true explanation of much that is mechanical in the so-called leisure of to-day, much of the delinquency, crime, suicide and lawlessness of to-day, as well as contributory factors in the more sinister aspects of unemployment or political movements. The rapid development of the industrial civilisation, out of proportion with social and moral or ethical development, threatens what McDougall describes as world chaos and Durkheim as 'anomie'—disequilibrium or planlessness.

Thus from the human side we are faced with the same necessity for intelligent control, for wider and wiser planning, for the expansion of the area within which a rational or scientific direction functions in place of prejudice, if mankind is to avert disintegration and regain control over events. In this rapidly changing world, man cannot assign a value to his work unless there is some sort of integral social background—unless in the human and social-political sphere we can replace haphazard guess and opportunist fumbling by precise knowledge of the type and extent of social change, comparable with our knowledge and technique in the physical world.

It is not of course suggested that industry, any more than science, bears the sole responsibility for this problem of social disorganisation. A period of exceedingly rapid economic growth, defects in our educational system as well as in political institutions, have all contributed to the present state of affairs. Both science and industry, however, do carry a sufficiently large share of responsibility to warrant an increasingly close concern on the part of scientific workers and industrialists with social and political problems.

Taxonomy and Phylogeny of Monocotyledons

The Families of Flowering Plants. 2: *Monocotyledons; arranged according to a New System based on their probable Phylogeny.* By J. Hutchinson. Pp. xiii + 243. (London: Macmillan and Co., Ltd., 1934.) 20*s*. net.

EIGHT years have elapsed since the publication of the first volume of "The Families of Flowering Plants", which dealt with the Dicotyledons. The author, in his preface to this his second volume, dealing with the Monocotyledons, apologises for the delay. At the time of the appearance of the former treatise, he confesses that he had then "only a cursory knowledge of the Monocotyledons as compared with that of the Dicotyledons". Perhaps if he had hastened the publication of the second volume, he might have produced a work somewhat perfunctory in character. As it is, whatever criticism may be brought against it, he cannot be charged with this. In the interval, Mr. Hutchinson has been able to exercise to the full on the Monocotyledons his flair for affinities, with the result that we have before us a work of much originality.

The book is compiled on similar lines to the previous one on the Dicotyledons, but with this amplification. Owing to the Monocotyledons being a less extensive group of plants, there is sufficient

space for the inclusion of keys to the genera of the families with the exception of the Orchidaceae and Gramineae. A serviceable key, however, to the tribes of the latter family is supplied by a colleague, Mr. C. E. Hubbard. In fact, thirty well-illustrated pages are devoted to the grasses, which happen economically to be the most important family of plants in the world and botanically one of the most difficult to master.

In the concise introduction, after reviewing and criticising the important taxonomic systems of the past as applied to the Monocotyledons, Mr. Hutchinson considers the question as to whether this subphylum should be regarded as mono- or polyphyletic, and decides strongly in favour of the former view. This is of intrinsic interest, for in his first volume he expressed the opinion that the Monocotyledons should be "placed after the Dicotyledons, from which they were derived at an early stage, the point of origin being the Ranales *and perhaps other groups*". The words now put in italics show that he has not prejudged the issue. He was then aware that a diphyletic origin had been proposed, namely, the derivation of the arum family (Araceae) and a few others from the peppers (Piperaceae) and the rest from the Ranales. After a full examination of the Monocotyledons as a whole (and it is well to bear in mind that the author has at his command the unrivalled dried and living collections of Kew), he rejects as highly improbable any direct piperaceous relationship, showing on the other hand how readily the aroids can be derived from the Liliaceæ.

There is general agreement, we think, that there is something more than mere superficial resemblance between the Ranales and the Helobiae. Hutchinson stresses this, and considers that a close relationship with the Dicotyledons is only shown at this point. For example, except for its single cotyledon and lack of endosperm, the genus *Ranalisma* of the family Alismataceae might equally well be placed in the Ranunculaceae. The Butomaceae are remarkable in sharing alone with the Cabombaceae the peculiar placentation in which the ovules are scattered over the inner surface of the free carpels instead of being confined to the margins. He does not touch on the vexed question as to the interpretation of the single cotyledon of the Monocotyledon in terms of the paired cotyledons of the Dicotyledon. He does, however, point out that some of the Ranunculaceae have only one cotyledon. Lyon, some years ago, argued for the inclusion of the Nympheaceæ in the Monocotyledons on cotyledonary grounds. Granting that the Monocotyledons had dicotyledonous ancestors, the reason for the change in the number of the seed-leaves is still obscure.

The absence of endosperm in all the Helobiae is certainly striking considering its presence in most other Monocotyledons and in nearly all the Ranales. Hutchinson comments on this and suggests that they have probably lost their endosperm through the adoption of an aquatic habit. This is not entirely convincing. The Araceae, for example, differ considerably among themselves as to the presence or absence of endosperm, but this variability cannot well be correlated with habit. Then in aquatic Dicotyledons, absence of endosperm is by no means the rule. In this connexion, it is interesting to call to mind that, in the Nympheaceæ, *Nelumbium* with the least-modified flower has an exalbuminous seed, whereas the other more advanced genera have endosperm.

The placentation of the ovules in the Butomaceae is remarkable, finding its parallel only in the Cabombaceae. This scattering of the ovules over the inner surface of the carpel is suggested as an ancient character, and so presumably as preceding the marginal position in evolution. On orthodox grounds it would be less disconcerting to regard it as derived from the marginal. Students of the carpel have singularly neglected this peculiar form of placentation.

As a basis for his new classification of the Monocotyledons, Mr. Hutchinson uses a character present in the apocarpous families which he regards of prime importance, the significance of which has hitherto escaped notice. This is the occurrence of a distinct biseriate perianth, the outer whorl of which consists of free usually green sepals and the inner of free coloured petals—in fact, a Dicotyledonous perianth except that the whorls contain usually three members each instead of five. It is of interest to note that trimerous whorls occur to some extent in the Ranales. From these apocarpous forms, three more or less distinct lines of evolution are traced. In one line through the Alismataceae reduction and sexual separation set in very early, producing an almost wholly aquatic branch, some of the forms, for example, *Zostera* and *Posidonia*, eventually adapting themselves even to marine conditions—an adaptation not yet attained by any Dicotyledon. This group of families is almost the same as those comprising Engler and Prantl's series Helobiae.

In the second line of descent, the calyx and corolla remain distinct, but the carpels are no longer free from one another. The spider-worts (Commelinaceae) come first, followed by the more-advanced Bromeliads, and as side branches from the former proceed families with a dry chaffy perianth culminating in forms with flowers in dense heads such as *Eriocaulon*. So far, this assemblage of families agrees fairly closely with

Engler and Prantl's series Farinosae. Hutchinson now places at the top the Scitamineae (bananas, cannas, gingers, etc.) which he designates as the order Zingiberales. These plants have been regarded as prototypes of the orchids on account of the reduction in the androecium being carried as far as unity, and also because in a few genera something suggestive of the orchidaceous labellum has been evolved. The author considers these resemblances to be merely parallelisms, and we are inclined to agree.

The third line of descent traced by Mr. Hutchinson is characterised by both whorls of the perianth becoming petalloid. They tend to be alike and to coalesce into a hexamerous corolla. The Liliaceae form the basic group. In this family are to be found genera with incipient syncarpy. It is here that the author makes one of his more striking departures from current taxonomy respecting the Monocotyledons. The Amaryllidaceae have for long been separated from the Liliaceae by the possession of an inferior ovary. This is an easily recognised distinction, but Hutchinson argues cogently that it is an artificial one separating forms evidently related. Instead he sees in the umbellate type of inflorescence subtended by an involucre of one or more spathaceous bracts a distinguishing character for the Amaryllidaceae, and consequently transfers from the Liliaceae to this family the tribes Agapantheae, Allieae and Gilliesieae. The onions are no longer to be associated with the lilies. The Welsh then in substituting the daffodil for the leek as their floral emblem was unconsciously obeying affinities. The hitherto somewhat unwieldy family of the Liliaceae is further restricted by the detachment of aberrant tribes to form separate families. These are named Trilliaceae, Smilacaceae and Ruscaceae. This is in keeping with the author's general practice of making the orders and families more natural and so in many instances less comprehensive, and thus easier of definition.

The absence of floral bracts in the tribe Heloniadeae is emphasised and on this account a relationship with the ebracteate Juncaginales is suggested. This tribe is considered a primitive one of the Liliaceae, but the absence of bracts, we think, must be held to be derivative through loss as in the case of the Cruciferae.

The very natural family Iridaceae is unaltered, except for the inclusion of the Tasmanian genus *Isophysis* (*Hewardia*) which has hitherto been placed in the Liliaceae on account of its superior ovary, though in all other respects it is iridaceous.

From the Liliales the other groups of Monocotyledons so far not mentioned in this review are derived. The ubiquitous and derided *Aspidistra* unexpectedly gains distinction as the connecting link between the lily and the arum families. The species of *Yucca*, *Dracœna*, *Agave* and kindred forms, largely arboreal in habit, are brought together in one order as leading up to the palms. The orchids, representing the highest floral evolution along entomophilous lines, are derived from Liliaceous stock through the Haemodoraceae, and finally, along anemophilous lines the culminating families of sedges and grasses are likewise traced from this stock through the rushes (Juncaceae).

New terms—Calyciferae and Corolliferae—are introduced for the two main divisions of Monocotyledons, based on the character of the perianth. A third division, the Glumiflorae, is then made for the rushes, sedges and grasses. Here there seems to be some inconsistency in taxonomic status. The Glumiflorae are a branch presumably of the Corolliferae and should therefore be a classificatory unit of lower rank. If raised to that of a division, then why not retain Helobiae as one too ? A very natural group of orders could thereby be associated.

This book, like its predecessor, is well illustrated by excellent line drawings. Many of these are original, from the author's own clever pen, which shows to especial advantage in the floral design surrounding the dedication to Agnes Arber of Cambridge in recognition of her classical researches on Monocotyledons. In it can be traced Mr. Hutchinson's views on the phylogeny of this branch of flowering plants.

In a work of this detailed and descriptive character, complete freedom from minor errors can scarcely be expected. Printers' lapses uncorrected, however, are few, suggesting careful proof reading. A few slips in arrangement and in the keys have been noticed. For example, the troublesome water weed *Elodea* is erroneously denoted as bisexual. The Posidoniaceae are missing in the key to the families of the Juncaginales. The words "Division III Glumiflorae" should have headed page 185. We notice also the use of the word 'biphyletic' instead of the more correct 'diphyletic'.

By the completion of "The Families of Flowering Plants", Mr. Hutchinson has definitely thrown out a challenge to those botanists who uphold Engler's classification, a system which has been largely followed on the Continent and to some extent in America, but only half-heartedly in Great Britain. One wonders whether it is soon destined to be superseded. Some remarks made by Sir Arthur Hill in his brisk foreword to this volume are of interest in this connexion. He writes as follows: "The lapse of eight years since the 'Dicotyledons' appeared has on the whole been

of advantage, since it has allowed botanists time to study and digest the earlier volume and to realise that not only do they appreciate the value of his [Mr. Hutchinson's] researches, but that they are also generally in agreement with his conclusions." This is encouraging to those who think that Mr. Hutchinson, in following such theorists as Hallier, Bessey and Arber and Parkin, is taking the right course. The Ranalian, or perhaps it might be better termed the Magnolian, type of flower is believed to be the least evolved, and from some such form all other kinds of flowers are held to be derived by modification and reduction. Hutchinson's new system is based on these ideas, and thus is diametrically opposed to Engler's, which postulates the primitiveness of unisexual flowers of few parts. His Monocotyledons, for example, begin with such genera as *Typha* and *Pandanus*. Hutchinson regards the flowers of these in just the opposite way, as more or less climaxes in reduction series—in fact, great simplification in the individual flower accompanied by much complexity in the inflorescence. Engler, however, in his last discussion on the phylogeny of Angiosperms, conceded an important point in allowing the primitive flower to be bisexual though still without a perianth or only a rudimentary one. Such a position leaves the origin of the perianth very much in the air.

It is well to bear in mind that, in the present state of our knowledge, theories bearing on the evolution of the flower can be based only, or at any rate mainly, on the comparative morphology of existing forms. The rocks so far help us little, though two groups of extinct plants, the Bennettitales and the Caytoniales, are sufficiently suggestive as to allow speculation to be advanced regarding the unsolved problem of the origin of flowering plants. Until crucial fossil evidence is forthcoming, surely it is more logical, as well as more suitable for teaching, to commence a system for their classification with plants having flowers of the Ranalian type than of the kind shown by *Typha*, *Pandanus* and the catkin-bearing trees. These latter plants may not be recent geologically, but that does not necessarily debar their flowers from having been derived by reduction. A comparative survey of existing Angiosperms shows how readily an entomophilous family can evolve anemophilous forms with reduction down to complete loss of the perianth, accompanied often by separation of the sexes. This has probably proceeded repeatedly from early times in Angiospermous history. The earlier an anemophilous branch has been given off, the less easy will it be to connect its descendants with any existing entomophilous family. In this way the isolation can be accounted for of such families as the Pandanaceae and Typhaceae.

In conclusion, Mr. Hutchinson is to be heartily congratulated on the completion of his "Families of Flowering Plants". Much information of an interesting, useful and suggestive character is compressed in its pages. Maps here and there are introduced to show the geographical distribution of families when this is especially striking. We commend the work to botanists generally and to systematists in particular. It is definitely written on phylogenetic lines. Taxonomy without phylogeny may be likened to bones without flesh. At the same time, the author is careful to state in his preface that his effort "represents only the beginning of an endeavour to establish a phylogenetic system for the Monocotyledons".

Mr. H. G. Wells Reveals Himself

Experiment in Autobiography: Discoveries and Conclusions of a Very Ordinary Brain (since 1866). By H. G. Wells. Vol. 1. Pp. 414+8 plates. (London: Victor Gollancz, Ltd., and The Cresset Press, Ltd., 1934.) 10*s*. 6*d*. net.

A CURIOUS post-War phenomenon is the spate of autobiographies and "ought-not-to-biographies" issuing from the publishers. The diapason of the War resounds in these books. Silent and abashed, we stand before the cenotaph. Some dream-child whispers: "What did you do, daddy, in the Great War ?" The hand gropes for the fountain-pen. Others, like Elihu, the son of Barachel, feel their bellies as wine which hath no vent, ready to burst. "I will speak that I may be refreshed." Mr. H. G. Wells's reason is akin to Elihu's—"to clear and relieve my mind". He explains that he has spent a large part of his life's energy "in a drive to make a practically applicable science out of history and sociology" (p. 26). A jewel has formed in his head and "through its crystalline clearness, a plainer vision of human possibilities, and the condition of their attainment appears" leading to "an undreamt-of fullness, freedom and happiness within reach of our species". Vast changes in the educational, economic and directive structure of society will be necessary. Details are reserved for the second volume to be published in a few weeks.

This first volume gives only hints of Mr. Wells's design for the new world he wishes to create. His life as a shop assistant, here realistically described, suggests a dream. The draper's shop. Enter a shabby old lady. "Our new model ? Certainly, *Moddom*. That counter ! Mr. Wells, forward." A not very impressive figure shuffles in, *our* Mr. Wells, munching the last mouthful of his bread and butter breakfast, sniffs contemptuously at

some dusty boxes labelled "Karl Marx—*Das Capital*", "Abolish the retail distributor", "Made in Russia", reaches down a box marked, let us suppose, "World-State", and with voluble dialectic succeeds in selling the new model for 1*s*. 11¾*d*., together with a packet of pins for the odd farthing. Quite possibly the old lady will find that the pins alone serve some really useful purpose. Our post-War world is full of irony. "To the saving of the universe," says Conrad, a man of powerful judgment, "I put my faith in the power of folly." If not folly, something simple, something unsophisticated—like the heart of a child. "The perfectly efficient," writes Gerald Heard in "These Hurrying Years", "is the perfectly finished." A re-birth has to take place—"foetalisation" is the scientific word. If Mr. Wells is going to tell us that the only way to save the world is to make it a macrocosm of Geneva—but we will not indulge in anticipations, Mr. Wells's own *cuvée reservée.*

Mr. H. G. Wells was born in 1866, "blaspheming and protesting", and this first volume of his autobiography takes us to the year 1896, during which he earned £1,056 7*s*. 9*d*., and had definitely mounted the pedestal of success. Students of the science of heredity will not find much raw material in his origin. His mother was "a little blue-eyed, pink-cheeked woman with a large, serious, innocent face", and his father's chief claim to fame before the birth of Mr. Wells—he was a professional cricketer—was having bowled four Sussex batsmen in four successive balls, a super-hat trick "not hitherto recorded in county cricket". In one of his reprinted letters (p. 400) Mr. Wells asks his parents: "If I haven't my mother to thank for my imagination and my father for skill, where did I get these qualities?" This may be a pleasing display of filial piety. Even with the help of his autobiography, Mr. Wells is not easy to explain, whether in terms of nature or of nurture.

His early education was spasmodic and was followed by apprenticeship to a draper. Emancipation came when Mr. Wells became a student of Huxley's at the Royal College of Science—then called the Normal School of Science—his training as a science teacher being subsidised by the Government with a weekly grant of one guinea. His unstinted praise of Huxley as "the acutest observer, the ablest generaliser, the great teacher, the most lucid and valiant of controversialists" confirms current opinion. After a year's course of general biology and zoology, "the most educational year of my life", the remaining two years of his course in the school were in the nature of an anticlimax. He writes with little enthusiasm of Guthrie, the professor of physics, who "maundered amidst unmarshalled facts", and with less of Judd, the professor of geology, to whom his antipathy was immediate; and he failed in his final examination in geology in 1887.

Tragedy? Not in the ordinary sense. The real tragedy was that Mr. Wells should not have continued study and research in biology under Huxley. He might have discovered the cause of human cancer, leaving to others the investigation of the cause and cure of world cancer. Academically he may appear to have been butchered to make a Juddian holiday but, with feline resuscitation, he soon took the B.Sc. degree of the University of London with first class honours in zoology and second class honours in geology, a remarkable achievement, appreciated strangely enough by no one more important than William Briggs, principal of the University Correspondence College, and of the University Tutorial College. For these institutions, Mr. Wells worked with diligence and success, until he abandoned teaching for literature, carrying away as booty one of his devoted women students, Amy Catherine Robbins, his second wife and mother of his children.

This is an interesting book—especially for those who have trodden the same Calvary without securing the same crown, undoubtedly golden in the case of Mr. Wells—warm, human and ingenuous, occasionally too ingenuous. The young man emulating Mr. Wells's colossal success who spends half a minted guinea to discover its secret will find (p. 157) that for some years Mr. Wells had two guiding principles in life: first, "If you want something sufficiently, take it and damn the consequences"; and secondly, "If life is not good enough for you, change it; never endure a way of life that is dull and dreary, because after all the worst thing that can happen to you, if you fight and go on fighting to get out, is defeat, and that is never certain to the end which is death and the end of everything". Has not the first principle created the chaotic world which Mr. Wells is obligingly going to set right? It is the *stupid* people, as Sir Walter Raleigh remarked in one of his letters, who make the work and then do it. Mr. Wells is not easy to explain. . . .

There lurks in Mr. Wells, on his own confession, "the latent 'Arry in my composition" (p. 388), exhibited in his references to religion, especially the unquotable account of his first communion (p. 189), and in the exposition of his private benevolences, including the inevitable Christmas turkey. Some lapses from Mr. Wells's high standard of scientific accuracy may be noted. The date of the great Education Act was 1870, not 1871 (pp. 84, 93, 327) and the diamond jubilee year was 1897, not 1896 (p. 403). T. LL. H.

Progress in Biochemistry

Annual Review of Biochemistry. Edited by James Murray Luck. Vol. 3. Pp. viii+558. (Stanford University, Calif.; Stanford University Press; London: H. K. Lewis and Co., Ltd., 1934.) 5 dollars.

RESEARCH workers and others interested in biochemistry have already begun to look forward to the date of the appearance of this review of the literature of the previous year. The volume appears with commendable punctuality; it is once again international in character, the twenty-six sections being written by experts working in Europe as well as in America. There is a tendency to make the reviews more critical in nature and less like mere reports: they gain in value accordingly.

A number of new subjects are selected which might be described as topical; in some of these a good deal of confusion exists, so that a critical review helps to bring clarity; in others there is definite progress to record. A stage is being reached when more definite views as to the course of metabolism are emerging, as, for example, the series of changes during glycolysis in muscle for which a new scheme has been put forward by Embden, whose tragic death is so greatly to be deplored, and substantiated by the work in particular of Myerhof. The series of changes from glycogen and glucose to lactic acid involving the formation of hexosediphosphate, the intermediate formation of pyruvic acid among other substances, and the action of enzymes at various stages, illustrate the complexity of the fermentation process, which not so long ago was regarded as a direct simplification of the glucose molecule. Even the phosphorylation is complex, for it apparently requires a co-enzyme system of adenosinetriphosphate, magnesium and inorganic phosphate. In explaining metabolism the biochemist seems to have abandoned any hope of simplicity.

One of the most useful reviews is that of Rosenheim and King on the sterols, a subject in which brilliant progress has been made. A new cholane formula devised by these authors which consists essentially of a reduced phenanthrene ring system has satisfied all the tests applied to it, and its adoption has acted as a stimulus to other work as, for example, the constitution of the œstrogenic hormones established by Marrian and Butenandt. It is remarkable that the phenanthrene nucleus is common to such physiologically active substances as calciferol, cardiacglycosides (strophanthin), toad poison (bufotoxin), carcinogenic hydrocarbons and œstrogenic hormones.

Hormones and vitamins still attract attention, likewise the animal pigments. A novel review is that on energy metabolism in nutrition, complete with symbols *SDA* and *BMR*, which is disproportionately long. On the other hand, the summary of biochemical and nutritional studies in the field of dentistry is a welcome sign of the entry of chemistry into this important subject.

More than a word of praise should be accorded to the excellent structural formulæ and the general printing of the book. E. F. A.

Short Reviews

Geomorphologie. Von Prof. Dr. Fritz Machatschek. Zweite Auflage. Pp. iv+154. (Leipzig und Berlin: B. G. Teubner, 1934.) 4.50 gold marks.

DURING the fifteen years which have elapsed since this little book first appeared, the science of geomorphology has undergone certain marked changes both in scope and application. This is seen, not least, in the important results which have been obtained by the application of geomorphological principles to the elucidation of problems connected with the deformation of the earth's crust, especially within the belts of young fold mountains. It is an important branch of geographical as well as geological science and, for this reason, a short yet comprehensive account of modern methods and results, suitable for the student, is very desirable. The present volume provides such an elementary textbook, and forms an admirable introduction to the study of the surface morphology of the earth.

The subject is treated from the genetical point of view throughout the book. For this purpose two main methods of investigation are employed: (1) a consideration of the different forces active at the surface of the earth and their ability to produce land forms; (2) a critical analysis of existing land forms in relation to their origin and development.

The first four chapters are of a general nature and deal with the physical and chemical forces which can be regarded as active agents in the modification of the earth's crust. The remainder of the book is devoted to a critical analysis of land forms under varying climatic and structural conditions. Five main types are recognised as follow: (1) the normal cycle of erosion; (2) erosion in humid climates; (3) erosion under polar conditions; (4) erosion in arid climates; and (5) islands and coasts. Within each type the modifying influence of structure is fully discussed.

Finally, the author provides a most useful appendix in which about one hundred terms of foreign origin are defined. The concise yet comprehensive nature of this little book should recommend it as one of the most useful textbooks available for the use of the elementary student.

Thorpe's Dictionary of Applied Chemistry. Supplement. By Prof. Jocelyn Field Thorpe and Prof. M. A. Whiteley. Vol. 1: *A–M*. Pp. xxi+680. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 60*s*. net.

IN order to make up the lee-way developed during a period of 7–13 years, two additional volumes are being provided as supplements to the original seven volumes of Thorpe's "Dictionary of Applied Chemistry". The present volume of about 700 pages is issued at the same price as the original volumes and covers the literature from *A* to *M*. Since the list of contributors to the new volume occupies five pages, an individual review of the articles which they have written is scarcely practicable; but the reader naturally turns at once to a 20-page supplement to the article on carbohydrates in vol. II, by Dr. E. F. Armstrong, to find the new ring-formulæ fully described and discussed. On the inorganic side, articles on hafnium and illinium are contributed by Prof. G. T. Morgan, whilst a long supplementary article on hydrogen by Prof. J. R. Partington includes ortho- and para-hydrogen, but was evidently completed at too early a date to include the isotopes discovered in 1933. Recent technical developments are represented by well-illustrated articles on coal gas and coke manufacture, on explosions and explosives and on iron and steel. A long supplementary article on analysis by Prof. G. T. Morgan is devoted mainly to the organic reagents which now play such an important part in the detection and separation of the metals, as well as of certain acid radicals. There are also many brief entries and cross-references which maintain the essential character of the dictionary as a work of reference for unfamiliar, as well as for the more familiar, names and subjects.

A very attractive feature of the new volume is provided by the use of heavy capital letters, not only for the main headings of the various entries, but also for the chemical formulæ, which are thereby rendered exceptionally clear and easy to pick out from the lighter type of the ordinary text.

The Casting of Brass Ingots. By R. Genders and G. L. Bailey. (Research Monograph No. 3.) Pp. xv+191+63 plates. (London: British Non-Ferrous Metals Research Association, 1934.) 15*s*.

THE attention being paid at the present time to the production of sound ingots of all kinds is well illustrated by the remarkable reports which are being issued by the Heterogeneity Committee of the Iron and Steel Institute, and by the work done on brass by the Research Department at Woolwich for the British Non-Ferrous Metals Research Association. Since a sound ingot is the essential starting point for sound products to be produced therefrom, this type of research, slow and tedious as it may be, finds most ample justification. The book under review is, in a collected form, the reports which have been prepared for the latter of the two research programmes mentioned above. To manufacturers of brass ingots for rolling it will be essential, but its importance extends much further than this. When at length the individual links can be welded into a comprehensive theory of the solidification of metals in moulds, the present work will not be the least useful. The amount of experimental information contained is large, the work has been well and patiently done, and the authors may be congratulated on the production of a volume of real value. The fact that the separate portions of the work were made the subjects of individual reports may possibly be the explanation of the one criticism which may be made, namely that there appears to be a certain lack of cohesion. F. C. T.

The Rôle of the Deserts. By A. J. McInerny. (The Channing Useful Pocket Series, 7.) Pp. 51+6 plates. (London: The Channing Press, 1933.) 4*s*. 6*d*. net.

MR. McINERNY here develops further his theories of the part played by the great deserts in human evolution. He holds that these great arid stretches of land in the Old World, extending from North Africa to Central Asia and from the Hindu Kush to Manchuria, are zones of disinfection which, by purifying the infected air coming from the tropical zones of jungle and swamp and causing it to be then distributed in the upper air to zones of development, have been the principal, though not the sole, factor in the evolution of man from the negro of the jungle to the yellow man of sub-arid areas and then the white race. Heidelberg man and Neanderthal man and related forms of extinct man are premature escapes from the zones of development. Mr. McInerny also turns his attention to America. Here, he holds, the influence of the deserts has not been strong enough to produce races capable of an advanced civilisation. In consequence, he is dubious as to the future of the white races now living on that continent. His views in their application to the question of ethnological affinities produce some new and startling results.

Perkin and Kipping's Organic Chemistry. Entirely new edition. By Dr. F. Stanley Kipping and Dr. F. Barry Kipping. Part 3. Pp. viii+615–967+xlii. (London and Edinburgh: W. and R. Chambers, Ltd., 1934.)

THIS volume deals with the more advanced parts of organic chemistry in the same clear and practical manner as the first two parts. A short but adequate account of the electronic formulæ of organic compounds precedes the consideration of various types of isomerism, and the discussion of important groups of compounds such as the monosaccharides, polysaccharides, cyclic hydrocarbons, terpenes, carotinoids, pyrones, anthocyanins, organo-metallic compounds and some selected heterocyclic compounds. There are several chapters on important theoretical matters, such as optical activity, isomeric change, the structure of benzene, and steric hindrance. The book gives in a reasonable space such information as an honours student may be expected to assimilate in the field covered, and it may be warmly recommended. In future editions, the structure of pyrones should be explained on a more modern basis, since quadrivalent oxygen is no longer admitted.

Nutrition in Relation to Disease

THE symposium on nutrition in relation to disease at the Aberdeen meeting of the British Association took the form of a joint meeting of Sections I (Physiology) and M (Agriculture). In the last ten years there has been a great development of research in the nutrition of farm animals. There are now two institutions—one at Cambridge and one at Aberdeen—devoted entirely to research in this subject. The meeting served the purpose of bringing together for review, results obtained in the medical field, where conclusions are drawn from experiments on small laboratory animals and from clinical observations on human beings, and those obtained in work with the larger domestic animals. Though the papers showed that the fundamental principles and the major problems are the same in both fields, they brought out the fact, sometimes overlooked, that the requirements for adequate nutrition and the effects of deficiencies of the various food constituents are not the same in all species. Dr. H. H. Green emphasised the necessity for caution in applying directly in medical or veterinary practice, results obtained with experimental animals.

The review showed that in the last twenty years, advance in knowledge has been so great that our ideas with regard to the etiology and treatment of many diseases have been revolutionised. It looks as if the science of nutrition may prove as important in the prevention of disease as the science of bacteriology.

In the case of certain deficiency diseases such as scurvy and rickets, the connexion between nutrition and disease is now established, and the dietary factor involved clearly defined. Investigators have moved on to the study of long-continued minor degrees of malnutrition which do not produce early gross signs of disease. To what extent do animals in this condition suffer from decreased resistance to bacterial or parasitic attack, and to what extent does this condition lead to the development of chronic diseases of digestion and metabolism ?

Dr. D. Robertson gave data to prove that in the case of coccidiosis in chickens and intestinal parasites in sheep, the state of nutrition of the animal is an important factor in determining both the extent and the effect of infestation. The results of these observations are now being applied successfully in practice. In the case of bacterial infection, carefully controlled experiments have shown that, with certain micro-organisms, animals in a poor state of nutrition show lowered resistance. In other cases, however, negative results have been obtained. This is a difficult field of inquiry, in which progress must be slow, as the nature and significance of immunological reactions are still obscure.

The bearing of nutrition on chronic diseases was discussed in each of the three leading papers (Dr. J. B. Orr, Prof. J. J. R. Macleod and Prof. S. J. Cowell). In the beginning of the present century, the influence of pathological conditions on metabolism was studied usually on the assumption that the abnormal metabolism was secondary to the pathological condition. The conception that disease may arise from a faulty diet has stimulated research from the point of view that the pathological condition is the result of the disordered metabolism, which may be present long before any clinical signs are evident. Data were given showing that in minor degrees of malnutrition the composition of fluids and tissues in the body is abnormal, and that these abnormalities give rise to dysfunction. It was suggested that the continued dysfunction might ultimately give rise to chronic disease. This condition is of special importance in early life. Deficiencies of certain substances in the food in the phase of active growth may lead to imperfect development of tissues, and so predispose to disease in later life. Dr. May Mellanby's paper on teeth illustrated the importance of perfect nutrition even in the pre-natal period.

In the present stage of very limited knowledge, the most that can be said is that the observations made are suggestive. Much patient and laborious investigation, however, is needed before we can speak with any degree of assurance on the relative importance of nutrition, heredity and environmental factors in the etiology of chronic diseases of metabolism. There is reason to believe, however, that this may be a fruitful line of inquiry. The study of some of these diseases from the nutritional point of view has already led to striking results. Ascorbic acid (vitamin C) seems to be effective in curing several diseases such as purpura hæmorrhagica, pyorrhœa and certain forms of hæmorrhagic nephritis. Progressive muscular atrophy seems to yield to treatment with an amino-acid, glycine. Psoriasis, in some cases at least, is cured by eliminating cholesterol and allied fatty substances from the diet. The treatment of pernicious anæmia with liver is now a well-established practice. These are diseases for which, until recently, medicine could provide no very satisfactory treatment. It may well be that these are merely the first fruits of the modern attack from the nutritional point of view on chronic diseases of obscure etiology.

The practical bearing of this recently acquired

knowledge on the incidence of disease was discussed by several speakers, and the results of investigations on the connexion between faulty diet and disease in the community were quoted in support of the suggestion that disease due to faulty diet is prevalent. Thus, an investigation showed that about 50 per cent of women of the child-bearing age among the working classes in one of our cities were suffering from nutritional anæmia. The addition of milk to the diet of school children was followed by 20 per cent increase in rate of growth and by improvement in health. A large proportion of children are evidently not attaining their full inherited capacity for health. It was suggested that much of the disease in later life may be due to malnutrition in childhood and that this may have a bearing on the large number of rejections of recruits from the army, owing to poor physique or chronic disease.

If, indeed, disease due to faulty dietary should eventually prove to be as prevalent as these isolated and limited observations suggest, then there are obvious economic and political implications, especially at the present time, when we are moving towards a planned economic system under which the amount of certain foodstuffs coming on the market and the price at which they may be retailed, may be fixed for purely economic reasons. As a matter of fact, we have not sufficient data to warrant making an authoritative statement on the subject. Experimental observations have been far too limited in extent and too academic in nature to permit of wide generalisation. Sir Frederick Gowland Hopkins wisely counselled caution in the interpretation of the limited facts available. The urgent need of the present time is large-scale investigations over a number of years in different sections of the community in order to obtain data which may be applicable to the populace as a whole.

Pit-Head Generation of Electric Power

(From a Correspondent)

In his presidential address before the Engineering Section at the recent British Association meeting at Aberdeen on "Sources of Cheap Electric Power", Prof. F. G. Baily advocates the establishment of electric generating stations at the pit-heads, his contention being that with low-grade coal and 'waste' fuel having a calorific value of 10,000 B.Th.U. per lb. available at a cost of five shillings per ton, electricity could be produced at one-twentieth of a penny per unit below the cost of production at the most modern steam stations now operating.

Prof. Baily very properly refers to the heavy burden of local rates on electricity undertakings, amounting in some cases to 0·1*d*. per unit sold, and suggests that a substantial reduction may be claimed such as a half, amounting to 0·05*d*. per unit which, with the equal saving which the pit-head station with cheap fuel can achieve, will bring about a reduction of 0·1*d*. per unit. The present cost of generation at large stations he puts at 0·25*d*. In this figure, 0·25*d*. per unit generated, rates (on the generating station alone), as Prof. Baily says, may amount to 0·06*d*. per unit, and on the whole undertaking often as much as 0·1*d*. per unit sold. This is a serious addition to the price which users of electricity have to pay. At least one undertaking selling many millions of units every year pays more in rates than it does for the coal required to generate all the electricity it sells. With the generating stations of industrial concerns de-rated, a substantial reduction in the rating of public utility stations appears to be a reasonable demand, but any reduction obtained would apply equally to the existing stations and to the proposed pit-head stations and would not affect a comparison between the two.

Prof. Baily visualises a pit-head station (perhaps many stations) having a daily output of about one million units. A saving of one-twentieth of a penny per unit would therefore be well worth striving for, and if such a saving could be effected it seems strange that nothing is being done to connect one such station to the Grid. It is only fair to say that such proposals are not new. In 1919 the Nitrogen Products Committee, with some of the most eminent engineers and other well-known scientific men of the day among its members, referring to the subject, said:

"It has often been advocated that large power stations should be situated at the collieries or even at the pit's mouth in order that the cost of coal delivered into the bunkers may be reduced to the lowest possible point. This would be perfectly sound provided the other principal requirement of a cheaply operated power station could be obtained at the same site, namely, an abundant natural supply of circulating water for condensing purposes, capable of being utilised without undue cost of pumping. In the case, for example, of a station loaded to 100,000 k.w. at least six million gallons of condensing water would be required per hour on a load factor of 95%—some 136,000,000 gallons per day. The only alternative to a large supply of cooling water is to use cooling towers with a consequent large permanent loss of water by evaporation and a considerable increase in the temperature of the condensing water leading to a serious addition to the

coal consumption of the Power Station. The constant loss by evaporation into the atmosphere amounts in practice to about 2% of the total, and as this is irrecoverable it has to be constantly made up from an outside source. In the case cited above of a 100,000 k.w. station operating on a load factor of 95% the employment of cooling towers would necessitate a daily supply of 2·72 million gallons of make up water to replace losses. . . . To sum up, the large power station at a colliery site having to rely upon cold water for condensing purposes involves an increased capital expenditure, an increased consumption of coal, a large initial supply of water for the towers and a large daily supply for make up purposes. . . . The Committee is not aware of any localities in Great Britain where natural supplies of condensing water of the magnitude indicated above can be obtained at the pit's mouth or in proximity to collieries and it is impracticable to transmit so large an amount of water over any considerable length of pipe. . . ."

In 1925 the matter was considered by the Coal Commission, which took evidence as to the practicability of having large generating stations located at the collieries. Then in 1926 the Board of Trade appointed the National Fuel and Power Committee to consider and advise upon questions connected with the economical use of fuels and their conversion into various forms of energy. This Committee made the following observation :

"The generation of electricity at the pit head is at first so very attractive that it is frequently advocated ; but consideration of all the relevant factors makes it evident that the cheapness of low grade fuel in a colliery district does not necessarily make it desirable that electricity for general public supply should be generated there. The determination of sites for future capital stations is in the hands of the Central Electricity Board, and the Electricity Commissioners and the Central Electricity Board will naturally take its supplies from the most economical stations. Where circumstances favour the erection of a station of large capacity in a colliery district there is no doubt that the saving in the transport of coal will give such a station added advantage. But the choice of a site for a generating station to supply a central network depends on a balance of considerations. The larger the capacity of the station, other things being equal, the lower is the cost of generation. The cost of transmission and distribution are also of importance and a station in the centre of a body of large consumers has an advantage in this respect. . . . It appears to us therefore that the question whether the Power Station should be at the pit or away from it or whether the colliery power station should be larger than is required to supply the colliery's own requirements or indeed whether the colliery power station is in any given case necessary at all, or whether the energy should not be taken from the national system must be decided on the merits of each particular case, having regard to local and district conditions. . . . We recommend that the possibility of the use of low grade fuel should be carefully considered when the site of any new electricity generating station is under consideration and when the plant for the station is designed and that the desirability of making any necessary adaptations of plant for the use of such fuel should be considered even for the existing stations. . . ."

It is fifteen years since the Nitrogen Products Committee issued its report, and Prof. Baily's answer to the criticism contained in it in regard to cooling towers, is that with the higher steam pressures now in use the reduction in efficiency due to the lower vacuum obtained with cooling towers is often exaggerated, and he mentioned the Hams Hall Station at Birmingham with a fuel consumption of 1·35 lb. per unit and an overall thermal efficiency of 23·34 per cent, in support of his contention. The Battersea Station on the Thames, Clarence Dock Station on the Mersey, and the Ironbridge Station on the Severn, may be mentioned as typical examples of coal-burning stations located at suitable centres. All three have a thermal efficiency exceeding 26 per cent, and no doubt this will be improved upon by the time any pit-head station is connected to the Grid.

The magnitude of the water problem may be judged by the fact that about 500 tons of water is circulated for every ton of coal burned, and last year more than 10½ million tons of coal were consumed at the stations of electricity supply authorities. There has been an improvement in recent years in the efficiency of cooling towers, but that improvement is scarcely sufficient to justify Prof. Baily's claim that "the absence of cooling water can be definitely disregarded as a disability in the use of pit-head stations".

The lower operating efficiency with cooling towers and higher capital cost, amounting to £100,000 in Prof. Baily's 100,000 k.w. station, are items which are not likely to be disregarded by those engineers who are responsible for the building of new stations or the extension of existing ones.

The suggested saving of one-twentieth of a penny per unit generated at the pit-head will suffer a further reduction when the cost of lines to connect it with the Grid are added. Prof. Baily suggests that transmission cost will be small, but sub-station equipment and duplicate lines would be necessary, and the cost in some cases considerable. The above-mentioned additional costs can, of course, be arrived at within close limits, but how is the price of 'waste' fuel having a calorific value of 10,000 B.Th.U. per lb. to be stabilised at 5*s*. a ton ? With generating stations built for the purpose of utilising this low-grade coal, it might become a main product, and with an increased demand the price would surely rise unless some agreement were made to keep it sufficiently low to enable the pit-head station to compete successfully with existing stations. In theory it is an attractive plan to use low-grade

fuel, cut out certain waste at the collieries and generally improve their efficiency, but the merits of such a scheme must rest on economic facts.

Prof. Baily bases his main comparison on stations working on a load factor of 40 per cent, but in future there will be two types of station in operation, the base load station working on a load factor of something of the order of 80 per cent and peak load stations operating on a poor load factor. Into which category are the pit-head stations to be put ?

We think there may be individual cases where a pit-head station will compare favourably with an existing selected station, but we can see no substantial evidence to justify any general scheme which would reduce the number or render redundant the existing base load stations. As soon as it can be proved that the pit-head generating station is capable of supplying energy to the Grid at a price below that of the most modern stations now connected to it we believe that: (1) capital will be found for such a station ; (2) the Central Electricity Board will be prepared to enter into a contract to purchase the whole of the station output ; and (3) the Electricity Commissioners will give their consent.

International Conference on Physics

SOME time ago, the Physical Society became convinced that results of value could be anticipated from an international conference on atomic (particularly nuclear) physics, and it was the intention of the Society to call such a conference this year. At the same time, the British National Committee for Physics—one of the constituent bodies which together form the International Union of Pure and Applied Physics—proposed to invite the Union to hold its next meeting in Great Britain.

It was a natural step to amalgamate these two functions, and the six-day meeting on October 1–6 has amply demonstrated the wisdom of that step. It was, we believe, the first occasion on which a meeting of the International Union had taken the form of a colloquium, and it brought together a most impressive array of physicists of note from many countries. The actual membership was nearly 600, of whom some 150 came from abroad. The international nature of the conference was perhaps best illustrated when an Italian, speaking in French, gave to the mainly English audience an account of recent work by a German who was unable to attend in person. The meeting was held in London in the rooms of the Royal Society and at the Royal Institution, and in addition, at the invitation of Lord Rutherford, one session was held at the Cavendish Laboratory, Cambridge.

The more formal business of the International Union included the ratification of a report on symbols and definitions, with which we hope to deal later, and the election of Prof. Niels Bohr to succeed Prof. R. A. Millikan in the presidential chair. In addition to this, the Union was responsible for the organisation of a discussion on certain problems of the solid state. In crystals, there is much evidence tending to show that, over and above the lattice regularity revealed by X-rays, there is a further definite structure, on a larger scale. The existence of such a block or mosaic structure was much debated, but assuming it to exist, it becomes a question of great interest to decide whether it is present inevitably, as a consequence of the need for the potential energy to become a minimum, or whether it is fortuitous, and due to something in the nature of flaws distributed statistically. The theoretical question involved here was discussed in one form or another at several of the meetings, and it seems likely that a solution will at least be expedited by the interplay of ideas and by consideration of the numerous suggestions made.

The most immediately obvious point about crystals is their lack of tensile strength, as compared with the value to be expected on theoretical grounds. The difference for rock-salt, for example, is about a thousand-fold, and two rival theories are in existence to account for this. One theory is that outlined above ; the other locates the weaknesses at cracks on the surface of the specimen. This crack theory receives strong support from many experiments where surface treatment alone has been found to alter the tensile strength considerably ; perhaps the most striking illustration is the discovery by Joffé and others, that the strength of rock-salt is increased twenty-five fold by merely carrying out the experiments in hot water. Of course, it must be borne in mind that a block structure might still exist, even if not needed to explain this particular fact. Much of the evidence for a block structure rests on data obtained by studies of plastic yielding, as well as on chemical facts and microscopic examination.

That part of the conference for which the Physical Society was directly responsible concerned itself with certain aspects, mainly experimental, of the recent advances in nuclear physics. It is true that fifteen years have elapsed since Lord Rutherford first succeeded in demonstrating that certain nuclei could be disintegrated by

bombardment with sufficiently swift α-particles, but at that time the products observed were always protons. We thought that nuclei were made up of protons and (negative) electrons. A few years ago, nuclear reactions were studied, using as projectiles not α-particles, but protons accelerated by means of intense electric fields produced for the purpose. This development was rapidly followed by the use of the newly discovered neutrons as bombarding particles, leading again to further nuclear reactions. Meanwhile, spectroscopy had given clear evidence of the actual existence of the hydrogen isotope of mass 2, and it was not long before this was separated, and its ions used as bombarding particles. At the same time, it was realised that the cosmic radiation with which space appears to be permeated, whether it is corpuscular or of wave-character, forms a powerful source with which Nature is continually carrying out disintegration experiments. Thus we may bombard any element with protons, deutons, neutrons, photons (including γ-rays) or α-particles, and may as a result obtain any one or more of these, either with or without ordinary negative electrons.

Even this, however, does not exhaust the list of particles. In certain reactions, the positive electron appears as a product. This is most clearly demonstrated in Wilson cloud-chamber photographs taken in magnetic fields, where the curvature of the track gives immediate evidence of the sign of the charge, whilst the nature of the track makes its electronic character evident. This particle is emitted as a product by the new radioactive elements discovered recently by M. and Mme. Joliot. These elements, which have lives varying from less than a minute to a few hours, are produced from ordinary elements by bombardment with neutrons, and there is no reason to suppose that the list of them is by any means complete. Indeed, Fermi has given reasons for supposing that, by bombarding uranium with neutrons, he has succeeded in producing a new element which is neither uranium itself, nor any of the five or six which immediately precede it in the periodic table. Consequently he suggests that it may be the element of atomic number 93 or 94, until now unknown.

As to the reactions which may occur in these various bombardments, it seems, as pointed out by Lord Rutherford, that practically any transmutation occurs (though the probabilities of the different reactions naturally differ) provided only that it is consistent with the energy laws. In this connexion, of course, a knowledge of the so-called 'mass-defects' is of primary importance, since they are so intimately related to the energy changes, in consequence of the Einstein law $E = mc^2$. Among these mass-defects, many are known with great accuracy from measurements with the mass-spectrograph or otherwise, but there is one particle, the neutron, for which the value of the mass-defect is uncertain.

This uncertainty is particularly regrettable since the values suggested lie on opposite sides of the mass of the proton, and consequently the relative stability of the two particles cannot properly be assessed. The higher of the two values put forward at the Conference depends on the assumption that, if one and the same element can be obtained as a product in two different reactions with the same initial reactants, then the energy content of that resultant is the same in both cases. Whilst the assumption is a reasonable one, yet the existence of certain isotopic isobars (isotopes with the same mass number) with different energy contents seems almost proved, when these are obtained in different reactions. If this can occur when the end-product arises from two different reactions, it may possibly turn out to be true that the isotopic isobars obtained by different mechanisms in a single reaction will also differ in energy, in which case the lower value for the mass of the neutron would hold the field.

It was suggested by Gamow at the Cambridge meeting of the Conference that the two forms of a single isotope referred to above might be explained if we could introduce another (not yet observed) particle, the negative proton, since in that case one form could contain a positive and a negative proton where the other contained two neutrons.

Even when we have added the negative proton to our list of particles, it is not complete. There is the 'neutrino', introduced by Fermi to maintain the conservation of energy, momentum and spin in β-ray emission. This particle, which is uncharged, has been discussed by several authors, all of whom conclude that its mass is much less than that of the electron.

Other papers, with which space does not permit us to deal, were concerned with the nature of the cosmic rays, which, besides being powerful agents in causing nuclear reactions, must of course be the products of such reactions, and are therefore to be studied also from that point of view.

In addition to the formal meetings, the social side was well cared for, and, further, many an informal discussion took place, which must certainly not be overlooked when we try to assess the scientific value of the Conference. All who attended seem agreed in hoping that another such meeting may be held in due course, and they will be well satisfied if it is equally successful.

J. H. A.

Obituary

DR. BERTHOLD LAUFER

THE death is reported of Dr. Berthold Laufer, of the Anthropological Department of the Field Museum, Chicago, and one of the foremost authorities on the art and antiquities of China. Berthold Laufer was born in Cologne on October 11, 1874, and was educated at the University of Berlin and at Leipzig, where he took his Ph.D. in 1897. In 1898–99 he travelled in Siberia as a member of the Jesup Expedition to the North Pacific and in 1901–4 was in China with the expedition of the Eastern Asiatic Committee. In 1904 he joined the staff of the American Museum of Natural History, New York, where he remained until 1908, acting, from 1905 until 1907, as a lecturer in anthropology at Columbia University. After spending the two years 1908–10 in Tibet and China with the Blackstone expedition, he was appointed in 1911 a curator in the Anthropological Department of the Field Museum, Chicago, a position which he retained until his death. He continued to travel in China at intervals during this, the most fruitful period of his life, and the collections of the Field Museum benefited enormously not only from his success as a collector of objects of ancient Chinese art, but also from his unrivalled knowledge of Chinese antiquities.

One of Laufer's most successful journeys was that on which he led the Marshal Field Expedition to China in 1923. His knowledge of the history of the domesticated plants and animals of China proved invaluable to the mission sent out by the National Research Council under the U.S. Department of Agriculture. Laufer was a voluminous writer, and produced a large number of very fully illustrated monographs on Buddhist and Tibetan literature, and Chinese archæology and ethnology, of which the best known are perhaps those dealing with ancient pottery, bronzes, jades and precious stones.

Laufer was exceptionally gifted as an orientalist, and his knowledge of the Chinese language and literature was of the greatest assistance to him in his work on Chinese antiquities; but in his writings on Chinese culture, whether dealing with objects of art or with the common objects of everyday life, such as agricultural implements or domesticated plants, he showed that he had at his complete command a wide range of knowledge of the material culture of other peoples of the world. While this added to the scholarly character and the value as comparative studies of his work, it led him at times, in the view of some, to be over-bold in speculation.

MR. H. A. ALLEN

HENRY ATTWOOL ALLEN, a former member of the staff of H.M. Geological Survey, died on October 3 at the age of seventy-nine years. Since 1919 he had been living in retirement at Eastbourne. Allen joined the Geological Survey as a temporary officer in 1875, and was attached to the Palæontological Department (then under the late Mr. E. T. Newton) in 1892, with the old title of 'assistant naturalist'. Here he was occupied with curatorial work on the fossils in the Museum at Jermyn Street, London, and he compiled several useful lists of types and figured specimens. These lists were published in successive numbers of the "Summary of Progress" of the Survey. He also took part in the identification of fossils collected during the progress of the Survey, his work in this direction being incorporated in sundry memoirs.

Before his retirement, Allen was a well-known figure on excursions of the Geologists' Association, and for some years acted as editor of the *Proceedings* of that body. He served on the Council of the Geological Society in 1911–15.

News and Views

The Retirement of Prof. A. Fowler, F.R.S.

A COMPLIMENTARY dinner to Prof. A. Fowler on his retirement after fifty-two years' association with the Royal College of Science, South Kensington, was held at the Imperial College Union on October 9. Dr. H. Dingle, assistant professor of astrophysics at the College, occupied the chair, and among the assembly, in addition to many old students and colleagues and the Rector of the College, Mr. H. T. Tizard, were representatives of a number of scientific societies, including Sir James Jeans, president, and Prof. W. W. Watts, president-elect, of the British Association; Prof. F. J. M. Stratton, president of the Royal Astronomical Society, Prof. H. H. Plaskett, Savilian professor of astronomy, Oxford, and Prof. Allan Ferguson, secretary of the Physical Society. In an eloquent speech proposing the toast of the guest of the evening, Dr. Dingle gave an outline of Prof. Fowler's career from the time when he entered the College as a scholarship student at the early age of fourteen and a half years to his appointment as Yarrow research professor of the Royal Society in 1923 from which he is now retiring. During almost the whole of this period, Prof. Fowler has been engaged in experimental research in spectroscopy, and his laboratory has become the chief centre of such work in the world. He is a leading authority on the identification and reproduction of celestial spectra, and his intuition and knowledge revealed in spark spectra series of lines which have fundamental significance in connexion with modern theories of the atom. In supporting the toast, Sir Richard Gregory said that metaphorically Prof. Fowler had for fifty years been listening to celestial language and music and had been successful in reproducing many of the fundamental notes, as well as analysing the over-

tones into a regular sequence. After hearing the morning stars singing together in their glory for so long, it was no wonder that they had influenced his character and made him to his many admirers only a little lower than the angels. The Rector of the College, Mr. Tizard, afterwards presented Prof. Fowler with an illuminated address, together with a writing desk, chair and a silver tea-tray from past and present colleagues.

New Science Buildings at Cambridge

FOUR important additions to the scientific laboratories at Cambridge will be available for public inspection on October 22, the occasion of H.M. the King's visit to open the new University Library. All, however, will have been in use since the commencement of the Michaelmas term, so that there will be no ceremony. These buildings, in so far as they are concerned with research, are paid for under a generous scheme agreed to with the Rockefeller Trustees, but, in addition, the University has built new teaching laboratories for the Zoological Department, the two top floors and part of the basement of its new school representing the Rockefeller contribution. The new wing for physiology is a building about 70 ft. by 50 ft. and 60 ft. high with five floors, of which the lowest is a theatre to hold 280 students. The first floor is devoted to pharmacology, and the second to chemical aspects of physiology, while the top floors represent advanced teaching and research; this wing gives the Department a total accommodation for more than forty research workers. Botany has received a 60-ft. extension of its previous building. The addition comprises an advanced lecture room and library extension on the ground floor. Half of the first floor is devoted to palæobotany, while the remainder of this floor and the second floor form a Sub-Department of Mycology, the top floor falling to advanced physiology. Agriculture has a new building largely devoted to offices, etc., but the Rockefeller scheme here is invaluable in the assistance given to research in animal physiology, in soil research and in statistics, among other subjects. Zoology retains its old Museum wing unaltered, but otherwise has an entirely new building with novel features that are likely to cause it to be most extensively visited on October 22. Rooms have been assigned in it to fifty-seven workers engaged in research work.

The Male Sex Hormone

ORGANIC chemists are well accustomed to spectacular results from the researches of Prof. L. Ruzicka and his school. Yet the artificial production of the male sex hormone recorded in the October number of the *Helvetica Chimica Acta* by Ruzicka, Goldberg, Meyer, Brüngger and Eichenberger probably transcends in interest any previous publication from the Zurich laboratories. Adopting the hypothesis of Butenandt, who first isolated and characterised the testicular hormone, that this substance is a hydroxyketone closely related to the sterols, Ruzicka and his collaborators examined the neutral fractions arising from the chromic acid oxidation of the acetate of dihydrocholesterol and some of its stereoisomerides. The removal of the sterol side chain by such oxidations has long been used for the identification of the side chain, but previous investigators had been unable to isolate the major fragment of the molecule. This has been achieved by Ruzicka, and the hydroxyketone resulting from *epi*dihydrocholesterol proved to be completely identical with the male hormone (androsterone) isolated by Butenandt. By this simple experiment, the structure of a complex natural product has been completely elucidated and its stereochemical relationship to the sterols established. Apart from speculation, the only previous chemical knowledge of the hormone was that it was a saturated hydroxyketone of the probable formula $C_{19}H_{30}O_2$. It is unfortunate that this conversion of cholesterol into androsterone should be described by the investigators as a 'synthesis'.

THE simplest biological test for the male hormone is its effect in promoting comb-growth in capons, and in this respect the artificial substance proved as effective as the natural hormone. A remarkable feature is the specificity of the hormone. Of the four stereoisomeric hydroxyketones obtained by the oxidation of dihydrocholesterol, *epi*dihydrocholesterol, coprosterol, and *epi*coprosterol, those from the last two compounds had no influence on the comb-growth of capons in daily doses of 1000 γ; that from dihydrocholesterol required daily doses of 500 γ for comb-growth, whereas the artificial hormone (from *epi*dihydrocholesterol) gave a response with daily doses of 70 γ.

The Chemist and Warfare

MR. J. DAVIDSON PRATT, secretary and general manager of the Association of British Chemical Manufacturers, addressing the Glasgow Section of the Society of Chemical Industry on October 5, discussed the part to be played by the chemist in schemes of national defence against attack from the air. He said that, in spite of the Geneva Protocol prohibiting the use of gas in war, it is necessary that the general public should be instructed in methods of defence, since some nations in signing the Protocol have made it clear that they would use gas if an adversary used it first. Gas used against an uninstructed civil population has a demoralising effect, but the publication of highly alarmist articles on the subject of poison gas attacks from the air by people whose knowledge of the subject is very limited is most undesirable. Mr. Pratt referred to the work which would fall to the chemist in the event of an air raid. He would have to be on the spot to identify the gas used, and would be required to decide quickly whether an area would require to be decontaminated or not, as some types of gas would be quickly swept away by the wind while other types would persist for a considerable length of time. The best method of defence for the civil population is the provision of gas-proof shelters, and every building should contain a gas-proof room. The chemist's advice would be required in selecting and fitting these rooms.

MR. PRATT then discussed the attitude of chemists to chemical warfare. He said that it has been suggested that chemists should bind themselves together and refuse to have anything to do with the manufacture of material which could be used in warfare. It has been stated that this scheme is not practicable because the chemical profession in most countries is not sufficiently organised and that it would require the co-operation of every nation, whereas the League of Nations itself has shown that it is impossible to get complete agreement on any matter of international policy. Another objection is that, in some countries, every citizen has to do as he is told, and in any event, in war, a man's first duty is to his country. In spite of these objections, Mr. Pratt insisted that the idea is worthy of further consideration because the alternative is so appalling that the chemist might well destroy the civilisation which he has been instrumental in creating, unless he insists that his inventions are not used for warlike purposes.

National Planning in Industry

THE need for sound national planning of industrial effort was emphasised in an address delivered before the Birmingham Group of the Institute of Industrial Administration on October 4, by Mr. Harold Macmillan, M.P., president of the Institute. Mr. Macmillan said that we have moved into a new economic society. The conditions of the nineteenth century world have passed away. In the old world Great Britain had great advantages. It was a pioneer nation and the workshop of the world, and on the whole the system was very satisfactory for the greater part of the nineteenth century. In the period preceding the War Great Britain exported capital to foreign countries, financed the market for its own exports and very largely developed the world. That system was very satisfactory while it lasted, but it has largely changed and to-day's problems have arisen almost entirely as the result of that change. The War quickened the pace, and the world has largely industrialised itself, economic nationalism prevails, and the balance of the world has been overthrown. The potential capacity to produce has increased at a rate far more rapid than the market to absorb.

AFTER referring to directions in which the War impeded British industry, Mr. Macmillan said that we have to face realities, and must not be content any longer to try to return to the past. We have to consider on what prosperity depends. It is the maintenance of certain balances—the balance between production and demand, and the monetary balance between the rate of saving and the rate at which savings re-enter a market in the form of investments. He does not think industrialists should be content to go on as industrialists in the same way as they did in the last two or three generations. Industrialists then did not bother themselves very much about monetary standards, but the last ten years have taught them how deeply concerned they are. National self-sufficiency is everywhere increasing. International trade barriers have to be overcome if the standard of living is not to fall. Unco-ordinated competition among ourselves for the home market weakens resources for obtaining export trade. Capital must contribute by acquiescence in a planned industry, and by demanding high professional standards from management. Management has to contribute by the more efficient co-ordination of functional activities and the elimination of waste in every form, and labour has to contribute by full co-operation resulting from a greater confidence in an industry so planned and conducted.

Friedrich Tietjen, 1834-95

THE centenary occurs on October 15 of the birth of the German astronomer Friedrich Tietjen who, in 1881, with Tisserand, E. C. Pickering, Tempel and Gylden, was made a foreign associate of the Royal Astronomical Society. Born in a village in the duchy of Oldenburg, Tietjen left school at the age of fifteen years to work on his father's farm, but some years later, having relinquished his right to the farm, he was able to attend the Universities of Göttingen and Berlin, and in 1862 at twenty-eight years of age became an assistant under Encke at the Berlin Observatory. Three years later, he became first assistant to Foerster, Encke's successor, and this post he held until 1874. In 1866 he discovered a minor planet, and in the same year, with Albrecht, carried out geodetic operations in connexion with the Mid-European Survey. In 1868 he went to the East Indies with Spörer and Engelman to observe the solar eclipse of August 18. An indefatigable worker and a remarkably facile computer, in 1874 he was made editor of the "Berlin Jahrbuch" and four years later succeeded Bremiker as editor of the "Nautisches Jahrbuch". With Foerster he also managed a school of instruction in scientific computation. He died at the age of sixty years on June 21, 1895, having suffered from ill-health for several years.

Nazi Philosophy and Truth

IT would be difficult to find a more complete and cynical indifference to freedom of thought and intellectual expression than appears in the speech, as reported in the *Times* of October 6, delivered by Dr. Frank, the Reich Commissar for Justice, on October 4 to the joint meeting of the Association of German Jurists, the Foreign Political Department of the Nazi Party and the teachers of economics in universities and other places of higher education. Dr. Frank is reported to have said: "as the pursuit of knowledge is the service of truth it must necessarily be service to National-Socialism. We insist that the unity of the philosophy which lies at the basis of National-Socialism must not be challenged by anybody." The exclusive and inviolable identification of philosophic truth with the principles and ideas of a dominant political faction, has a familiar ring which would have provoked no surprise had it come from the mouth of a politician, but its uncompromising terms are startling when uttered by a commissar for justice, who has been responsible for the recent reorganisation of jurists throughout Germany. More was to follow. Dr. Frank went on to say, "Our aim

must not be originality or novelty in books, but the promotion of national welfare, of national safety, of national wealth and national solidarity. There must be no more battles of theory among you." He goes on to bid the teachers of law and economics show the way to German intellectual life by their good example. By a strange perversion of logic, policy dictated by political expediency is made the touchstone of truth and teaching, research and speculative thought are to be conditioned by predetermined conclusions, outside the terms of which they may not stray. The restrictions placed on the study of race and the history of culture are evidently now to be extended to jurisprudence and economics.

Clinical Research at Guy's Hospital

THE governors of Guy's Hospital and the governors of Guy's Hospital Medical School have accepted an invitation from the Medical Research Council to co-operate in the establishment of a new 'unit' for scientific research work in clinical medicine. It has been agreed that the Council will provide the salary of a whole-time director and of his assistants, with the cost of all apparatus and research material used by the unit. For its part, the Hospital will provide suitable laboratory accommodation free of charge, and will place and maintain beds at the disposal of the director: the latter is to be *ex officio* a member of the visiting staff, with a seat on the Medical Committee and the committees of the Medical School. These arrangements are to be effective for a period of five years in the first instance. Dr. Ronald T. Grant, hitherto working in the service of the Council in the Department of Clinical Research at University College Hospital, London, has been appointed director of the new unit. The invitation was issued to Guy's Hospital by the Medical Research Council in accordance with its general policy of improving the facilities available in Great Britain for the scientific study of disease in the human subject, and with this end in view of increasing the number of higher appointments for whole-time workers in this field. The financial resources which the Council is able to apply to the purpose are those which were released when the senior post formerly maintained by the Council at University College Hospital, and held by Sir Thomas Lewis, received permanent endowment through the generous action of the Rockefeller Foundation.

Electrical Launching Gear for Lifeboats on the *Queen Mary*

THE electrical generators of the *Queen Mary* have a total capacity of about 10,000 kilowatts. There are in addition two 75 kilowatt generating sets driven by Parsons oil engines, which can be used for emergencies. Messrs. Samuel Taylor and Sons, Ltd., of Brierly Hill, Staffs, are supplying all the launching gear for the lifeboats. It includes twenty-four sets of gravity davits and winches. These davits run down inclined trackways carrying the boat with them until they finally reach their outboard position, when the boat is lowered from the davit head into the sea; the whole operation is done without stopping, the motive power being gravity. The cradle holding the boat is made in two portions, the carriage and the arm. The two portions run down the track bodily, after which the arm swings out of the carriage until the boat attains the outboard position and the lowering begins. There is no jerk anywhere, the motion being continuous. The movement of the davit is controlled by an electric winch mounted on a deck house. The winches are fitted with patent speed-sustaining brakes which limit the lowering speed of the lifeboats to one foot per second. For raising the lifeboats, after they have been lowered for any reason, such as lifeboat drill, the electric motors are used. Limit switches are provided which check the movement when the davits reach their inboard position and the interlocks make it impossible for the operator to make a mistake.

Mining in Great Britain

THE thirteenth annual report of the Secretary for Mines for the year 1933 from the Mines Department, which includes as usual the annual report of the Chief Inspector of Mines, has recently been issued (London: H.M. Stationery Office, 1934. 3*s*. 6*d*. net). The most important statement in this report is to be found in a review of the British coal-mining industry, which states that "Signs of an improvement in the position of the British coal-mining industry were evident in the latter part of 1933". This is a very satisfactory statement as showing that the coal production of the country is at last recovering from the serious slump that has affected it for so long. It must not, however, be supposed that all the difficulties have been overcome, because the report goes on to state that work at the pits was most irregular and that the prices of British coal were slightly lower than in the previous year. It is shown that various trade agreements made with different Governments of Europe have resulted upon the whole in an advantage to the coal trade of Great Britain. It is satisfactory to find that the utilisation of coal and the products derived from it are on the increase, and that serious attention is being given to the question of the use of compressed gas for motors. The statement, though now old, that during November 1933 the Secretary for Mines opened the first public filling station for vehicles using compressed gas, is repeated in the report, and it is decidedly interesting to have it thus authoritatively stated. It is obvious from the report that the mining of iron improved during 1933, the increase in the output being more marked in the second half of the year than in the first, as in the case of coal. The remainder of the report of the Secretary for Mines is not of great scientific importance, although his summary of the results obtained in the various testing stations is of a certain amount of public interest. The report of the Chief Inspector of Mines is, as usual, mainly of importance for the numerous tables which it presents.

Weekly Weather Reports

THE *Weekly Weather Report* of the Meteorological Office, Air Ministry, for the period February 28,

1932–February 25, 1933, in the British Isles, is the fifth of a new series that began with vol. 45, published in 1929; the introduction to that volume explained the changes introduced in the new series. The week is commonly regarded as the unit of time best suited to the needs of agricultural meteorology, and this report is designed in other respects with the same needs in mind—for example, 'accumulated temperature', which is calculated with 42° F. as base, above which many forms of plant begin to grow, and statistics of ground frosts, that is, frosts registered by a thermometer set on the grass and freely exposed to the sky as are the upper surfaces of the leaves of the topmost sprays of plants, are among the items included. The tables are set out in such a way that the whole year's succession of weekly data for a single station occupy one page. There are 57 stations, well distributed throughout the British Isles; these are also grouped into twelve so-called 'districts', and the deviations of the various meteorological elements, temperature, rainfall and sunshine, from normal values of these elements for a long period (generally 1881–1915) are averaged so as to give 'district values'. The district values are set out for individual weeks, and these are grouped into the four seasons, for each of which there is an appropriate seasonal mean deviation from normal. The season under review was one of generally deficient sunshine with more than the usual rainfall. The data for the Midlands and for the eastern districts of England and Scotland would be suitable in a study of the agricultural results of a wet spring, as that season was notably wet in those districts.

Investigation of the West Kennet Avenue, Avebury

MR. ALEXANDER KEILLER has reported briefly in *Antiquity* of September on the results of an examination of the West Kennet Avenue, which leads from the Great Circle of Avebury to the Stone Circles on Overton Hill, undertaken recently with the view of determining its exact line. The Avenue has never been excavated scientifically; and in the spring of the present year operations were begun in a field about five hundred yards long near the middle of the course. Eight stones were still visible there, as well as one stone, which had never fallen, and one which had been re-erected by Mrs. Cunnington in 1912. The work began in April, and was planned to occupy three seasons. Fallen stones, or stones discovered beneath the surface, are being re-erected in the original holes as the work proceeds. Up to the time of writing, one buried stone, of which the previous existence had been unsuspected, and one fallen stone had been re-erected. In all, eight stone-holes have been discovered on the eastern side of the Avenue and eleven on the western side. One stone hole, despite careful searching, remains undiscovered. It is thought that the stone for which it is sought may not have penetrated the sub-soil, as the soil at the point where this stone most probably stood is unusually deep. Four other buried stones have been found and on three of these are markings which may be inscribed ornament. Post holes for timber uprights of which traces remain may, it is thought, represent a habitation site. The associated pottery is of the type known as Neolithic *B*, that is, Peterborough, which in this region belongs to the secondary occupation of the neighbouring Windmill Hill. Two finds of foreign stone, broken polished axes, are of augite-granophyre from Graig Llwyd. This occurs only at Penmaenmawr, North Wales, and previously only three specimens had been recorded outside Wales, one being from Windmill Hill, and equating with Neolithic *B* pottery.

Experimental Soil Science

THE experimental study of the soil is so essential a branch of courses in agriculture, horticulture, botany and biology, that it seems a pity it is rather neglected, especially in the last two subjects, from elementary school courses up to courses in the universities. Most textbooks of botany, for example, devote little space to soil science in spite of the fact that the soil is the sole environment responsible for the physiological, biological and edaphic factors affecting one of the most important organs of the normal plant, namely, the root. We would therefore direct the attention especially of teachers of elementary biology and botany to an article on the experimental study of the soil by Dr. B. A. Keen, assistant director of Rothamsted Experimental Station, in *School Nature Study*, vol. 29, No. 117, October 1934. The author describes 18 experiments with a running commentary divided into four sections: what is meant by soil; organic matter; mineral matter; and separation of soil constituents. The paper is also published separately as Leaflet 22, copies of which can be obtained at 2½*d*. each, or 2*s*. a dozen, from Mr. E. G. Clarke, 7 Stanley Avenue, Wembley, Middlesex.

Gulls Destroy Grasshoppers

IT is surprisingly seldom that one comes across telling examples of the activity of birds as destroyers of harmful insects. F. Bradshaw records an interesting experience in Canada, on the west side of Last Mountain Lake, east of Liberty, Saskatchewan (*Canadian Naturalist*, **48**, 68, April 1934). On June 18, 1933, he observed there what in the distance appeared to be a cloud of smoke, but on nearer approach turned out to be enormous flocks of the black-headed Franklin's gull. They alighted in column formation and gorged upon an army of grasshoppers. The number of birds present could not be estimated closely, but the column of close-set birds was a mile in extent and sixty birds in width, and two miles to the south-west an even larger cloud of gulls was seen. Estimates suggest that a Franklin's gull might devour 500 grasshoppers daily; the protective value of a flock, which at a very conservative estimate numbered more than a million, is, therefore, of considerable moment.

Giuseppe Peano

AMONG the eighteen papers in the *Rendiconti del Seminario Mathematico e Fisico di Milano* (7, 1933), the longest, and, to the general reader, most interesting, is an account of the scientific work of G. Peano of Turin (1858–1932). His publications, numbering

more than two hundred, ranged over pure and applied mathematics, logic, philosophy, grammar, comparative philology, international languages, and even politics. Some early papers dealt with the algebra of invariants. He then turned to calculus and differential equations. His 'space-filling curve' has been described as one of the most remarkable results in the theory of aggregates. The investigations of the foundations of geometry and arithmetic are of great importance, but his crowning achievement is his system of mathematical logic, with its elaborate symbolism (the 'Peanese' ridiculed by Poincaré), which has been used in England by Russell and Whitehead. Peano applied his logical methods to grammar, and this led to other linguistic studies, including the invention of the international language Interlingua. As a contrast to his abstract work may be mentioned his methods for the approximate solution of problems in practical mathematics. He stands out in the history of science as one of the few modern thinkers who have combined profound originality with a wide range of activities.

The Indian Mathematical Society

THE jubilee commemoration volume of the *Journal* of this Society contains, in addition to the usual research papers, an account of the history of the Society. It began in a very modest way in 1907, when Mr. V. Ramaswamy Aiyyar, then deputy collector at Gooty, formed the "Analytical Club", the object of which was to subscribe for mathematical periodicals and circulate them among the members. In 1909 appeared the first number of the *Journal.* By the end of 1910, the name of the Society had changed twice, first to the "Indian Analytical Club" and then to the "Indian Mathematical Society". The number of members, originally about twenty, is now nearly three hundred. A central library is maintained at Poona, and conferences are held biennially in different parts of India. The Society is conducting an inquiry into the present conditions of mathematical teaching and examinations in schools and colleges, with the view of introducing certain reforms, and is also trying to set up prizes for research. It is considering the advisability of dividing its *Journal* into two parts, an advanced part for the publication of research papers, as at present, and a new elementary part, similar to the *Mathematical Gazette* or the *American Mathematical Monthly.* The achievement of which the Society is most proud is the discovery of the great Indian mathematician Ramanujan, whose contributions began to appear in the *Journal* in 1911. In the present volume, the place of honour is given to two papers developing Ramanujan's results.

The Automatic Telephone

WE think that an elementary knowledge of automatic telephony is almost a necessity to every well-educated young man. We therefore welcome the brief description in pamphlet form of the processes involved in making a call on the automatic systems of the British Post Office. It forms an excellent supplement to the demonstrations given daily on the automatic telephone equipment installed at the Science Museum by the Post Office. The various ways in which a call can be made are described and illustrated by four simple diagrams. It is possible with the aid of the pamphlet to understand the main features of automatic telephony without going too deeply into technicalities and manufacturing expedients. The pamphlet (price 6*d.*) is published by H.M. Stationery Office, and is useful for reference.

Regulations for the Electrical Equipment of Buildings

THE Institution of Electrical Engineers has just published the tenth edition of its regulations for the wiring of buildings. The ninth and preceding editions were entitled the "I.E.E. Wiring Rules". This publication is very opportune, for the wide use of luminous discharge tubes and 'all electric' receiving sets has introduced several new problems as to the necessary requirements and precautions required for ensuring satisfactory results and providing immunity from fire and shock. The regulations do not take the place of a detailed specification but are supplementary to it. We think that any wiring system which complies with the instructions laid down in this little book (price 1*s.*) will be found satisfactory. The Wiring Regulations Committee has obviously taken great pains in its preparation. The definitions of the technical terms used are clear and the instructions for testing the completed installation are very good.

Congress of Anthropological and Ethnological Sciences

THE September issue of *Man* is devoted to the first session of the International Congress of Anthropological and Ethnological Sciences which was held in London on July 30–August 4. A group photograph in three sections of the members of the Congress forms the frontispiece of the issue, and a general survey by Prof. J. L. Myres, one of the general secretaries, opens the report. Full summaries are given of Lord Onslow's presidential address on "Anthropology in Administration" and of the Huxley Memorial Lecture by Sir Aurel Stein, as well as of the evening discourses delivered by Prof. T. C. Hodson on the census of India, by Dr. R. R. Marett on the tendency of anthropological studies and by Prof. J. B. S. Haldane on "Anthropology and Human Biology". The proceedings in each of the eleven sections among which the work of the Congress was distributed are briefly reported either by the sectional president or the secretary. As some delay is inevitable before the volume containing the full account of the proceedings with abstracts, etc., is available, this very full report is not only welcome, but also will be extremely useful for purposes of reference until a more authoritative source is available.

Boots Pure Drug Company's Medical Products

MESSRS. BOOTS Pure Drug Co., Ltd., Nottingham, have issued a small booklet about the therapeutic uses of medicinal glucose or anhydrous dextrose. Glucose is usually given by mouth but may be administered by rectum or intravenously. Its great advantage over other forms of carbohydrate in the

diet is that it is absorbed without change and so provides an easily assimilable foodstuff. The list of indications for glucose therapy is lengthy, including acute infections, conditions of malnutrition and more specifically hepatic toxæmias and insulin hypoglycæmia. The gonococcus vaccines issued by Messrs. Boots Pure Drug Co., Ltd., are prepared in the Department for Venereal Diseases at St. Thomas's Hospital, London. Three types of vaccine are available—a simple emulsion of gonococci, a detoxicated vaccine, making it possible to inject with safety a considerably larger dose, and also a mixed vaccine of gonococci with streptococci, staphylococci, diphtheroids and coliform bacilli, organisms commonly found in gonorrhœa complicated by secondary infection. The organisms in all vaccines are killed by the addition of 0·5 per cent phenol. The vaccines appear to be of distinct value in the treatment of all gonococcal infections, although it may be advisable to defer their use until the acute symptoms of urethritis have subsided. The number of organisms in the vaccines ranges from 200 to 10,000 million per c.c.

Announcements

THE Council of the Institution of Civil Engineers has made the following awards: Baker Gold Medal to Ralph Freeman (London). For papers read and discussed at ordinary meetings: Telford Gold Medals to Dr. J. J. C. Bradfield (Sydney, Australia) and to Ralph Freeman (London); Webb Prize and Telford Premium to W. E. Gelson (Delhi); Indian Premium to J. D. Watson (Lahore); Telford Premium jointly to Ralph Freeman (London) and Lawrence Ennis (London); Telford Premium jointly to E. F. Law (London) and Vernon Harbord (London); Manby Premium jointly to J. F. Pain (Winchester) and Gilbert Roberts (Margate); Trevithick Premium jointly to R. W. Foxlee (London) and E. H. Greet (Iver, Bucks.). For papers published without discussion as "Selected Engineering Papers": Telford Premiums to E. F. Reid (London); jointly to F. W. H. Stileman (Weybridge, Surrey) and J. S. Young (Perth, Australia); to E. H. Bateman (Birmingham); to A. C. Gardner (Glasgow); to W. G. Morrison (London); to B. C. Hammond (Worcester); Crampton Prize to G. M. T. Rees (Gerrards Cross, Bucks.). The Charles Hawksley Prize has been awarded to H. G. Cousins (London) and the Coopers Hill War Memorial Prize to F. V. Appleby (Brighton).

THE Carnegie Institution of Washington, Washington, D.C., has issued its annual catalogue of publications (pp. xlv+131). A few copies of each publication are reserved for sale at prices below printing cost, and price lists or classified lists may be obtained upon request.

THE National Council of Social Service would be very grateful for gifts of second-hand microscopes and telescopes. There are four training centres at which selected unemployed men are instructed in subjects which can be carried on in the Clubs to which they belong. There is a strong desire for instruction in scientific subjects and there are no funds wherewith to buy the instruments. Gifts should be sent to the Secretary, National Council of Social Service, 26 Bedford Square, W.C.1.

A SERIES of 'class' catalogues of the books in the Library, including the Departmental Libraries, of the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, is in course of preparation, the first of which has just been issued. This contains the books in Class B (Natural Science). University theses are included, but not periodical publications and pamphlets. The works are classified under subject headings which in many cases are duplicated, and are arranged chronologically by date of publication. The entries are abbreviated to the barest essentials, and an alphabetical index to the subjects represented in Class B is appended. The work will be sent gratis upon request to the Librarian.

MESSRS. HUTCHINSON'S Technical and Scientific Book Co. are publishing a new "Technical and Scientific Encyclopædia" under the editorship of Messrs. C. F. Tweney and I. P. Shirshov. It is being issued in about forty weekly parts (1*s*. 6*d*. a part); and Part 1, which has just appeared, contains 48 double-column pages. The type is small but clear, the headings stand out plainly, and many of the short descriptive articles are accompanied by useful diagrams. It is proposed to cover the whole field of science as it is applied in industry. The editors have secured the services of a very competent panel of contributors, each of whom deals with his own particular subject. A list of standard books and papers on each subject is promised in the concluding parts.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An instructor in the Department of Mechanical Engineering, Leeds College of Technology—The Director of Education, Education Offices, Leeds (Oct. 15). An executive engineer in the United Provinces Service of Engineers (Irrigation (Hydroelectric) Branch)—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Oct. 20). A lecturer in veterinary hygiene at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Council, County Hall, Chelmsford (Oct. 24). A principal and head master of the Gravesend Technical Institute and Junior Technical School—Mr. W. A. Clench, Bank Chambers, Windmill Street, Gravesend (Oct. 27). A lecturer in biology at the Warrington Training College, Wavertree, Liverpool, 16—The Principal. An assistant conservator of the museum of the Royal College of Surgeons of England, Lincoln's Inn Fields, W.C.2—The Secretary (Nov. 8). Research workers to take charge of nutritional research under the Indian Research Fund Association at Coonoor—The High Commissioner for India, India House, Aldwych, London, W.C.2 (Nov. 30). A water and drainage engineer for the Simla Municipality—The Secretary, Municipality, Simla, India (Dec. 10). An assistant for work in connexion with research in aeronautic instruments in the Directorate of Scientific Research, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Thermal Decomposition of Acetaldehyde

IN the note which I contributed on behalf of the workers in my laboratory to the discussion at the meeting of the Royal Society on May 10, it was stated that our results showed that the rate of thermal decomposition of acetaldehyde was influenced by the state of the surface of the silica, which was contrary to the conclusion arrived at by Hinshelwood and Hutchins[1], who had stated that the process was "practically entirely homogeneous". When I had read my note, Mr. Hinshelwood commented on my statement, and according to the report of the meeting which has just been published said,—"In our experiments the decomposition of acetaldehyde is an absolutely homogeneous reaction unaffected by the character of the vessel." A reply demanded reference to the actual facts recorded by Hinshelwood and Hutchins, and I proposed to look up the paper and submit one in writing, but I was not permitted to do so. As Mr. Hinshelwood built up his hypothesis on the results of these and similar experiments, it is worth while considering how far his deductions are legitimate, and I take this opportunity of making a few observations regarding them.

In the paper to which I have referred, it is stated that in two experiments carried out at 518°, in which two different silica bulbs were used, values of the velocity constant were obtained, (I) 0·333 0·352, (II) 0·350 0·349, showing a maximum difference of only 3 per cent. When one of these tubes was packed with silica chips, the values of the constant obtained were 0·461 0·477, the maximum increase being 43 per cent. In experiments at 464° the value for the constant with the empty bulb was 0·049 and for the packed bulb 0·066, the increase being 35 per cent. The authors argue that because the surface of the silica chips represented an area of some twenty times that of the empty bulb, the increase in the velocity constant is negligible. They assume that the effect of unit area of the broken silica and of the fire-polished surface of the tube are identical, which is not in accordance with experience. These experiments merely show that with different tubes treated in a similar manner one may obtain almost identical results, but that the effect of surface is not negligible. With this we are in perfect accord. Certainly the data do not justify the statement that the thermal decomposition of acetaldehyde is "absolutely homogeneous".

Mr. Hinshelwood's suggestion that the effect of surface would only be observed at low temperatures is negatived by subsequent experiments in my laboratory. His second suggestion that our experiments were affected by the condensation of oxygen on the walls of the reaction tubes is not supported by the facts. It is our invariable practice to fill a reaction tube with hydrogen, and to heat it overnight to about 600°. It is then exhausted while hot, cooled, and the measured quantity of acetaldehyde vapour is condensed in it, after which it is sealed. There is no chance of oxygen coming into contact with the surface. The removal of oxygen from liquid acetaldehyde, in which the gas is very soluble, is a very difficult matter. It was effected by distilling the liquid *in vacuo* at low temperature through a series of vessels sealed together, and finally condensing it in the filling apparatus without contact with air.

The pre-treatment of the tubes with hydrogen for some hours enables one to obtain concordant results in the case of most reactions when using the same tube, but only in the case of very few reactions with all the tubes used. Indeed, out of a large number of reactions which we have studied, only in the case of the pyrolysis of ethane-ethylene-hydrogen equilibrium mixtures does the effect of surface appear to be practically negligible. Even in this case I should not care to use the word "absolutely", even in the broadest and most popular sense. The criteria of surface action are very obscure, and two or three experiments with similar tubes, treated in an identical manner, are insufficient to determine whether the influence of surface is material or not. The experiment described by Dr. A. Farkas at the recent meeting of the British Association, in which D_2 was replaced by H_2 by heating it in a silica tube which was supposed to be completely degassed by the usual high temperature and high vacuum treatment, suggests caution in dealing with the results of gas reactions carried out in silica apparatus.

Actually the main difference between our experimental results and those which I have discussed lies in the fact that, in one case the reaction rates are measured by observing the rate of formation of methane, which requires detailed analysis, and in the other they are deduced from the total rise of pressure, from which it is not possible to eliminate the effect of side reactions.

M. W. TRAVERS.

University of Bristol.
Sept. 16.

[1] *Proc. Roy. Soc.*, A, **111**, 384.

Human Daily Requirements of Dietary Ascorbic Acid

EARLIER investigations[1] on insane, but physically healthy, experimental subjects, who have been forcibly tube-fed owing to their refusal to take nourishment, have established certain relations between the protective dose of an antiscorbutic required by man and the protective dose of the same antiscorbutic required by a guinea pig, on the view that the degree of susceptibility to microscopic scorbutic alterations in the teeth in guinea pigs and the prescorbutic reduction in the strength of the cutaneous capillaries in man are approximately the same. On the basis of this result, further experiment showed that, in order barely to protect himself against the earliest onset of a shortage of vitamin C, an adult weighing 60 kgm. requires a daily dose of an antiscorbutic (fresh orange juice) fourteen to twenty times as large as a guinea pig weighing one third of a kilogram requires barely to protect itself against scorbutic alterations in the teeth which can be determined microscopically. In a further investigation, these facts have been utilised to establish indirectly man's daily requirements of ascorbic acid by means of experiments on guinea pigs.

Of thirty guinea pigs with initial weights between

260 gm. and 336 gm., three were put on each of ten different doses of ascorbic acid, increasing regularly by 35 per cent, of the following amounts: 0·4, 0·54, 0·73, 1·0, 1·33, 1·80, 2·42, 3·27, 4·4, 6·0 mgm. The ascorbic acid was a crystallised preparation from the Chinoin factory in Ujpest.

The basal diet in the guinea pig experiments was of the following composition:

48 parts of crushed oats.
24 „ „ wheat bran.
15 „ „ dried skim-milk powder autoclaved for 2 hours at 110° C.
10 „ „ melted and strained butter-fat.
2 „ „ raw egg yolk.
1 „ „ sodium chloride.
0·1 „ „ Osborne's nutrient salt.

The diet was given for 50 days. A fresh solution of ascorbic acid was prepared every day and given to the animals by means of a pipette graduated in 0·01 c.c.

At the end of the experimental period, the microscopical investigation of the molar teeth[2] showed that microscopic prescorbutic alterations were found up to 1·0 mgm. dose, but that they were absent with the 1·33 mgm. dose and with the larger doses, while protection against *macroscopical* scorbutic alterations had been reached with 0·5 mgm. 1·33 mgm. is thus the smallest dose of ascorbic acid which insures protection to the guinea pig against microscopical prescorbutic alterations in the molar teeth.

If, on the basis of this result, a calculation is made using the relation previously ascertained between the ascorbic acid requirements of man and the guinea pigs, it is found that the smallest daily dose of ascorbic acid which, given *per os*, protects a person weighing 60 kgm. against the slightest objectively ascertainable prescorbutic alterations—those in the capillaries—is 19–27 mgm.

GUSTAF GÖTHLIN.

Laboratory of Physiology,
University, Uppsala.
Sept. 4.

[1] G. F. Göthlin, *Skand. Arch. Physiol.*, **61**, 252–259; 1931.
[2] G. F. Göthlin, *Acta Medica Scandinavica*, Supp. 53, 22–26; 1933.

Action of Oestrin on the Coagulating Glands and on certain Vestigial Structures in the Mouse (*Mus musculus*)

THE appearance of a squamous keratinising epithelium in the coagulating gland of the mouse following the prolonged administration of oestrin has been recorded by Lacassagne, de Jongh, and Burrows and Kennaway. In these earlier observations, the effects observed were regarded as occurring in the prostate. More recent work by the author has shown that the organ characteristically affected in this way is the coagulating gland, the separate nature and function of which were first discovered by Walker in 1910.

Under the prolonged influence of oestrin this structure becomes converted into a sac lined by stratified, keratinising epithelium. The wall of such a sac resembles microscopically that of the vagina and is capable of undergoing alterations which recall those of the oestrous cycle as occurring in the latter organ. If the administration of oestrin be stopped, the stratified, keratinising epithelium disappears from the coagulating gland and is replaced by a single layer of cuboidal cells which resume their normal function; that is to say, they secrete a fluid which coagulates the contents of the seminal vesicles immediately after ejaculation. Coincidentally with these restorative changes the gland ceases to retain the obvious form of a sac, its walls again becoming much plicated as in the normal state.

A metaplasia similar to that mentioned above has also been observed in two other situations in male mice which have undergone prolonged treatment with oestrin.

(*a*) In some mice—though not in all—which have had long-continued treatment with oestrin a sac has been found on the dorsal aspect of the prostatic urethra between the distal ends of the vasa deferentia and projecting towards the peritoneal cavity immediately behind the urinary bladder. Such sacs, the largest hitherto observed measuring 13 mm. × 13 mm. × 10 mm., are lined by a stratified, keratinising epithelium, and, like the uterus in the female after similar treatment with oestrin, are distended by clear fluid. The lower ends of the vasa deferentia are displaced by these sacs and the coagulating glands are closely associated with their lateral walls. It seems probable that these sac-like structures should be regarded as representing the utriculus masculinus, persistent in some individuals only and rendered manifest through the action of oestrin. Rauther states that, in the new-born mouse, between the distal ends of the vas deferens there is a small slit-like vesicle ending in two short tips. This he regards as a utriculus masculinus. He affirms, however, that no remnants of Müller's ducts are to be found in the adult mouse. Regarding this statement, which is contradictory to Leuckart's observations, it may be remembered that vestigial structures show some inconstancy in their persistence and post-natal development, and any generalisation as to this persistence in the adult of a particular species can be made only after the examination of a large number of individuals.

(*b*) Recently, in a mouse which had undergone treatment with oestrin for a period of 62 days, a structure, consisting of a number of tubules lined with squamous epithelium and filled with keratinised material, has been found in connexion with the epididymis—where vestiges of the cranial end of Müller's duct might be expected. The plane dimensions of this structure in a microscopic section are 2 mm. × 3 mm.

The foregoing observations suggest, subject to further inquiry, that oestrin may perhaps have a specific action on structures derived from the Müllerian apparatus, and may be of value in the study of certain embryological problems. In connexion with such a hypothesis is the possibility, which awaits proof, that the coagulating glands are in fact derivatives of the Müllerian ducts. These glands open into the dorsal wall of the prostatic urethra close to the orifices of the ejaculatory ducts on their cranial side—a position which seems compatible with such an origin.

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Jongh, S. E. de, *Acta Brevia Neerl.*, **3**, 112; 1933.
Lacassagne, A., *C. R. Soc. Biol.*, **113**, 590; 1933.
Leuckart, R., *Göttinger Studien*, 259; 1847.
Rauther, M., *Jenaische Z. Naturwiss.*, 377; 1904.
Walker, G., *Johns Hopkins Hosp. Bull.*, **21**, 182; 1910.

Science at the Universities

MR. TIZARD's address[1] to Section L (Educational Science) of the British Association calls for certain comments. In view of the existing unemployment among scientifically trained men and women, he calls for a reduction in the number trained in future, and suggests that it is a good policy deliberately to keep the supply somewhat short of the demand, at least in the case of biologists. This may be economically sound from the point of view of persons already trained in biology, who would thus acquire a scarcity value, like those pigs which have survived the recent massacre of their species in the United States.

But is it a sound policy from the point of view of the community, and should a biologist regard himself as a mere commodity ? Whatever may be the case with engineering, I submit that training in pure science has value of another kind. A century ago the founders of this College wrote[2] : "It is rather for another class of sciences, the knowledge of which is not profitable to the possessor from the pecuniary point of view, but which exert a great influence on the well-being of society, that such an Institution was required." I find little trace of this idea in Mr. Tizard's address. Yet I believe that it is still true, and that a training in biology is of value not merely for success in science, but also for success in citizenship.

Whether or not this is true, many students, who are interested in science for its own sake, believe that they are regarded as mere commodities. This belief is one cause of the spread among them of revolutionary views, in which I fear Mr. Tizard's address, if it is taken as expressing the general views of university authorities, will go far to confirm them.

J. B. S. HALDANE.

University College,
London, W.C.1.
Oct. 2.

[1] NATURE, 134, 405, Sept. 15, 1934.
[2] Report of Council, 1833.

The Philosophy of Sir James Jeans

DR. JEFFREYS and I do not always agree ; but I want to support him against H. D., who misses the point[1]. If in the days of the 'old' physics, there was in existence a 'philosophy' applicable to the 'new', that is evidence that there is not nearly as much difference between the old and the new as Jeans, Eddington and their followers pretend. That is what Dr. Jeffreys and I maintain ; the argument is unaffected by the number of people who held the 'philosophy'.

I want to support him too concerning the neglect of inference. Indeed, I would go further than he. The only way to discover what science means is to study how its conclusions are reached. Interpretations of science that are not based on a theory of inference are worthless. Unfortunately, Dr. Jeffreys and I differ concerning inference ; and so, at the risk of self-advertisement, I want to point out that his argument, restated above, supports my view.

My doctrine of inference, expounded in my "Physics", depends on an essential distinction between laws and theories, which everyone else ignores, and leads to a particular view of the logical structure of theories. The doctrine was based on a study of the 'old' physics ; but Dirac's great book (which is the Bible of the 'new') might have been written (of course it was not actually written) to illustrate the doctrine. Dirac starts, as I said he should, in defining his 'hypothetical ideas' and stating his 'hypothesis' ; he then formulates his 'dictionary' in a separate section. The only difference between a typical 'old' theory (such as the kinetic theory of gases) and a typical 'new' theory is that the 'analogy' is mechanical in the former, mathematical in the latter. But, as I pointed out, there were mathematical theories even in the old days.

NORMAN R. CAMPBELL.

155 Hagden Lane,
Watford, Herts.
Sept. 28.

[1] NATURE, 134, 499, Sept. 29, 1934.

Cosmic Rays and the Earth's Potential

IN a recent communication[1] I have outlined a theory of the origin of cosmic rays in which the earth is regarded as a magnetised sphere carrying an electric charge, and the cosmic rays as charged particles which are drawn to it by electrostatic attraction. I find, employing the dynamics of relativity, and assuming that the particles possess small energies at great distances from the earth, that the theory leads to the following conclusions : if the earth, regarded as an isolated sphere, has a potential of 3×10^{10} volts, particles bearing a single atomic charge can reach it only at magnetic latitudes greater than 60°, while if its potential exceeds $1 \cdot 5 \times 10^{11}$ volts, the earth's magnetic field does not greatly influence the geographical distribution of the intensity of the radiation. Consequently, the particles should arrive at the earth's surface each with an energy the value of which expressed in electron volts lies between these limits. A potential of 6×10^{10} volts is just sufficient to bring the particles to the magnetic equator.

Calculations by Lemaître and Vallarta[2], who suppose the earth to be magnetised but uncharged, and the particles to be projected towards it from all directions, afford the values 10^9 and 5×10^{10} electron volts for the corresponding limits of the energies.

It is significant that Kolhörster[3] has detected cosmic rays in a salt mine and concludes that the minimum energy of the primary cosmic rays must exceed 10^{11} electron volts, while Compton[4] states, "Regarding the more penetrating component, we must conclude that if they are electrified particles, they must have an energy of 3×10^{10} electron volts or more".

In addition to affording satisfactory numerical agreement with these observations, the theory of a charged earth gives a simple explanation of the fact that cosmic rays arrive with equal intensities from all regions of the heavens, so that it is unnecessary to adopt the somewhat unsatisfactory hypothesis that space is filled with particles moving with vast energies in all directions.

With the earth at a potential of 7×10^{10} volts, the particles would arrive at the equator at an angle of 60° with the vertical from a westerly direction if positively charged, but from the east if they carry negative charges, so that there exists a possibility

of testing the theory by experiment and also of determining the sign of the earth's charge, should the theory prove correct.

Details of the calculations and other aspects of the theory are given in a paper which will appear elsewhere.

I have found since writing my first communication[1] that the hypothesis of a radial cosmic electric field, with the earth near its centre, had previously been suggested by T. H. Johnson[5] in an attempt to account for his observation that the primary corpuscular radiation is exclusively positive.

L. G. H. HUXLEY.

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Leicester.
Sept. 15.

[1] NATURE, **134**, 418, Sept. 15, 1934.
[2] *Phys. Rev.*, **43**, 87; 1933.
[3] NATURE, **132**, 407, Sept. 9, 1933.
[4] NATURE, **131**, 713, May 20, 1933.
[5] *Phys. Rev.*, **45**, 569; May, 1934.

Distortion of the Crystal Lattice of α-Brass

WHEN a metal is cold-worked, its X-ray spectrum is modified. In most cases, this modification includes a diffusion of the diffraction lines. If the diffused lines are photographed in an X-ray camera giving high dispersion, and analysed with the aid of a microphotometer, it is found that, in general, the broadening does not take place symmetrically about the normal position of the line.

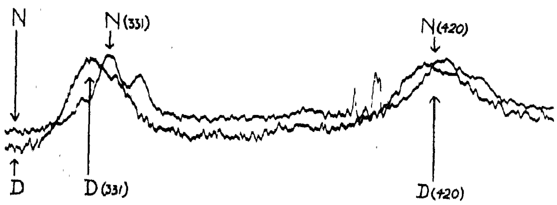

FIG. 1.

This observation is illustrated by the accompanying microphotometer record (Fig. 1). It is selected from results obtained on specimens of α-brass which have been cold-rolled to different degrees. The curve marked *N* shows the trace of the (331) and (420) lines of the spectrum; these are given by a normal annealed specimen. That marked *D* is the corresponding trace, taken on the same record, from the same specimen but after deformation has occurred. For convenience of illustration, the photographic negatives were placed in the microphotometer carrier in such a way that the (420) line of the normal specimen was made to fall directly above that of the cold-worked specimen. It is seen that the (331) line of the latter is then definitely displaced relatively to the normal (331) line; it differs in position and in intensity distribution.

This means that the deformation of the metal is accompanied by a change in the average size and shape of the unit cell, and by a change in the latent energy of the crystal lattice.

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Sept. 14.

Raman Spectrum of Nitrosylsulphuric Acid

THE structure of nitrosylsulphuric acid is being investigated by Raman spectra. The acid was prepared by bubbling sulphur dioxide into specially purified nitric acid to which a small amount of glacial acetic acid had been added. A solution of nitrosylsulphuric acid in commercial 100 per cent pure sulphuric acid was examined using a Hilger Raman spectrograph and Ilford New Double X-Press plates. The spectrum obtained after $6\frac{3}{4}$ hours exposure was rich in Raman lines. Raman displacements of 424, 549, 730, 915, 1043, 1181 and 1378 cm.$^{-1}$ were obtained. These clearly arise from the sulphuric acid and are in good agreement with previously recorded values. In addition, a number of other lines due to the nitrosylsulphuric acid were present; most of these were faint, but one corresponding with a displacement of 2340 cm.$^{-1}$ had an intensity comparable with the intensities of the sulphuric acid lines.

Further work is in progress, and a full discussion of the results will be published elsewhere.

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A. H. LECKIE.

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Inorganic and Physical Chemistry,
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London, W.C.1.
Sept. 20.

Denitrification in Sunlight

THE ordinary denitrification taking place in the absence of oxygen and in presence of an easily oxidisable organic substance and a nitrate effected by many micro-organisms, is well known. There is another variety of nitrogen loss, which takes place in presence of oxygen, but has not yet been satisfactorily explained. It will be evident that this loss of nitrogen from the soil, which may amount to double the quantity of nitrogen taken up by plants, is due to an oxidation process followed by a photochemical and catalytic decomposition.

J. G. Lipman and A. W. Blair[1] have shown that nitrogen in the gaseous state is lost from soils when the conditions are favourable for oxidation. The loss amounted to 100 lb. per acre per year in the first nine inches of the soil, both in New Jersey and California. In these experiments, the conditions existing in the soil in the past were disturbed by making the soil suitable for more oxidation. Similar nitrogen losses have been observed at Rothamsted, Minnesota, Kansas, Indian Head (Saskatchewan), Nagpur (India) and other places. Nearly 70 per cent of the added nitrogen is said to have been lost when wheat plots in Rothamsted have received 14 tons of farmyard manure containing 200 lb. nitrogen. These losses are more pronounced in soils which have been highly aerated.

That the oxidation of ammonium salts is an important factor in this type of denitrification is also evident from the following observations. Niklewski[2] reported that when the manure was free from nitrifying bacteria, only 3 per cent nitrogen was lost as ammonia but when supplied with nitrifying bacteria, the manure lost more than 20 per cent of its nitrogen. Moreover, Russell and Richards[3] have observed a greater loss of nitrogen when a manure was composted under aerobic than anaerobic condition. Vishwa Nath[4] has obtained greater nitrogen loss and velocity of oxidation in the nitrification of

ammonium salts than with farmyard or green manure. Moreover, the total amount of nitrate present in soils with crop is less than that in neighbouring fallow soils, even when correction is applied for the amount of nitrate taken up by the crop. Neller[5] has concluded that much more rapid oxidation takes place in the soil with growing plants than in the uncropped soils under identical conditions.

These observations on nitrogen loss can be explained from the following considerations: The soil invariably contains some ammonium salts. By the process of nitrification, which is an oxidation reaction, the ammonium salts are first oxidised to nitrite. In other words, ammonium nitrite may be produced in the soil when a supply of air is available. Dhar[6] has observed that solutions of ammonium nitrite decompose into nitrogen and water when exposed to sunlight, and this photochemical decomposition is facilitated by acids and different solid surfaces. Recently we have carried on several experiments by exposing solutions of ammonium salts alone and mixtures of ammonium salts and sodium nitrite mixed with sterilised or unsterilised soil or surfaces like TiO_2, ZnO, Fe_2O_3, etc., to sunlight, and we have observed marked decomposition of the ammonium nitrite in light. The loss of nitrogen in the dark is always much less than in light. Similar decomposition of ammonium nitrite formed temporarily in the soil from the processes of ammonification and nitrification is likely to take place in Nature. This decomposition of ammonium nitrite in the soil will be more evident when virgin or prairie soils are ploughed for cultivation. The organic nitrogenous compounds present in the soil have a chance to be oxidised first to ammonia and then to nitrite and finally to nitrate by the increase of aeration effected by ploughing.

It seems that in the soil, normally the processes of ammonification and nitrification can go on simultaneously, and thus at a certain stage in the processes of oxidation, ammonium nitrite may be generated, and this being an unstable substance specially in presence of light and the soil surface acting as a catalyst, will decompose with the liberation of gaseous nitrogen. Moreover, when the nitrogenous manure is in large amount and there is sufficient aeration, the possibility of the formation of the easily decomposable ammonium nitrite is increased. For the production of ammonium nitrite in the soil, aeration is necessary and that is why Russell and Richards observed more marked loss of nitrogen in aerobic than anaerobic conditions as already reported. In tropical countries, the formation and decomposition of ammonium nitrite formed in the soil are marked because of the high temperature and strong sunlight; like sunlight, high temperature also facilitates the oxidation of nitrogenous compounds and the decomposition of ammonium nitrite. The greater loss of nitrogen in cropped soils than in uncropped ones is evident from the fact that there is more oxidation taking place in soils with growing crops than in fallow lands.

This process of denitrification can be minimised by the addition of carbonaceous substances, which retard the oxidation of nitrogenous compounds.

N. R. DHAR.

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Allahabad, India.

1 *Soil Sci.*, **12**, 1; 1921.
2 *Rocznikow Nauk Rolniczych*, **9**, 1; 1923.
3 *J. Agric. Sci.*, **10**, 22; 1920.
4 *Sci. Reports, Dept. Agric. Madras*, 1930–31.
5 *Soil Sci.*, **10**, 29; 1920.
6 *Proc. K. Akad. Wetensch. Amsterdam*, **23**, 308; 1920.

The Fungus on *Zostera marina*

THE fungus *Ophiobolus halimus*, which has recently been described as parasitic on *Zostera marina* L., has this summer been discovered on this plant in the British Isles. It has been found in several localities in Devon (Plymouth, Cawsand, River Yealm, Salcombe), the north coast of Guernsey and Lough Ine, Ireland. Dr. E. J. Butler has compared the British material with authentic specimens of *O. halimus*, Diehl et Mounce, recently described on *Z. marina* on the Atlantic coast of North America[1], and finds it to be identical with the Canadian material.

It was at first thought that this fungus might be *O. maritimus*, Sacc. (*Rhaphidophora maritima*, Sacc.), which is stated by Saccardo to grow on *Zostera*, but inquiries instituted by Mr. A. D. Cotton led Prof. E. Ulbrich, of Berlin, to re-examine the type specimen collected by Magnus, when it was found that the fungus occurred on a leaf of a grass, probably *Elymus*, but certainly not *Zostera*. This identification was afterwards confirmed at the Kew herbarium, where the type specimen was sent on loan. The incorrect statement that *O. maritimus* occurred on *Zostera* was due to an error by Saccardo, for Magnus expressly states on his label that the habitat was "unter *Zostera*", not "auf *Zostera*". Taking into account the morphological differences in the description, there can be, therefore, no question of the fungus which is at present so abundant on *Zostera marina* being *O. maritimus*, Sacc.

Assuming that Dr. H. E. Petersen's recent note[2] refers to *O. halimus*, the known distribution of this newly described fungus is as follows: parts of the Atlantic coast of North America (not in the Woods Hole district[3]), Ireland, south-west England, Channel Islands and Denmark.

The widespread occurrence of the fungus on *Z. marina*, and its absence on *Z. nana*, Roth (at least in the Plymouth neighbourhood), suggests that *O. halimus* may perhaps be partly responsible for the disappearance of *Z. marina*, but it is impossible to make any definite statement at present as to this. Experiments on its pathogenicity are in progress at the Marine Biological Association's laboratory at Plymouth.

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Citadel Hill,
Plymouth.
Sept. 13.

1 Mounce, Irene, and Diehl, W. W., "A New *Ophiobolus* on Eelgrass", *Canadian J. Res.*, **11**, 2, 242–246; 1934.
2 Petersen, H. E., "Wasting Disease of Eelgrass", NATURE, **134**, 143; 1934.
3 Renn, C. E., "Wasting Disease of *Zostera* in American Waters", NATURE, **134**, 416; 1934.

Alleged Stimulation of Moulds by Paraffin in Heavy Water

IN a letter to NATURE of July 21, Dr. R. Klar suggests that the increased growth of moulds in 0·5 per cent heavy water observed by Meyer[1] and by Larson[2] was produced by an unsuspected paraffin impurity. A brief consideration of the facts, however, will show that such an explanation is untenable. Organic matter of paraffin nature influences the growth of certain moulds and bacteria (*Penicillium*, *Actinomyces*, tuberculosis bacteria) solely by serving as a source of carbon (Rahn[3], Büttner[4], Haag[5], Tausson[6], Hopkins and Chibnall[7]) and consequently

a trace of paraffin would be without effect in the experiments of Meyer and Larson in which an abundance of more suitable carbon sources is present. Haag[5] writes: "... Bacterien wachsen auf den Paraffinstückchen nicht, wenn andere Kohlenstoffquellen (Glyzerin, Zucker) vorhanden sind". In Meyer's tests sucrose was added as a carbon source and in Larson's experiments the moulds were growing in the tissue of the flatworms. It is inconceivable that a trace of paraffin could account for the sixteen-fold increase in dry weight of *Aspergillus* reported by Meyer.

Dr. Klar states, "it is clear that the water used ... was twice-distilled", but it is not clear to us how he is in a position to describe our technique, which was not mentioned in the communication. As a matter of fact, the 0·5 per cent heavy water is stated by the manufacturer to contain 0·01 per cent alkali and a trace of organic matter. We therefore distilled five times, including twice from concentrated permanganate, and we fail to see how any significant impurity could survive this treatment and exert an effect under conditions in which salts and organic nutrients are added to both the heavy water and controls. Moreover, we found that 0·06 per cent heavy water was without a noticeable effect on moulds even after being in contact with rubber stoppers coated in paraffin.

The results with moulds are supported by the greater length of life of *Spirogyra* and Planaria and the slight slowing down of zymin and pancreatin to which results the paraffin explanation could not be applied. Also, Richards[8] has found an increase in dry weight of yeast in our dilute heavy water.

I do not doubt Dr. Klar's experiments showing that paraffin in the absence of other material may support the growth of certain moulds—indeed, this has been known for more than a quarter of a century.

T. CUNLIFFE BARNES.
Osborn Zoological Laboratory,
Yale University.
Sept. 7.

[1] *Science*, **79**, 210; 1934.
[2] NATURE, **133**, 873, June 9, 1934.
[3] *Centralb. Bacteriol.*, Pt. 2, **16**, 382; 1906.
[4] *Archiv. Hygiene*, **97**, 12; 1926.
[5] *ibid.*, **97**, 28; 1926.
[6] *Biochem. Z.*, **193**, 85; 1928.
[7] *Biochem. J.*, **26**, 133; 1932.
[8] *Amer. J. Bot.*, **20**, 679; 1933.

Mitogenetic Radiation of the Urea-Urease System

ALL fermentative processes hitherto investigated have been found to be accompanied by mitogenetic radiation; but owing to the complexity of the substrata and the mechanism of splitting, it is not always possible to attribute radiation to a certain phase of fermentative splitting. Therefore it is of interest to study radiation in rather a simple system. We have chosen the system of urea-urease.

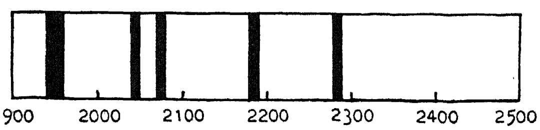

FIG. 1.

The ferment has been obtained from an extract of soy bean flour deprived of fat and urea, used in 5 per cent solution. The methods of investigation and in particular those of spectral analysis have been the usual ones employed in our laboratory and recently described in Prof. Gurwitsch's recent monograph[1].

The spectrum of radiation (Fig. 1) has been established on the basis of about three hundred experiments. The whole mitogenetic region has been broken up into strips of 10 A. width.

In a number of other experiments in our laboratory, it has been ascertained that all substrata subject to fermentative disintegration are also capable of emitting secondary radiation when irradiated by mitogenetic rays. Urea is no exception, and by radiating it we have succeeded in obtaining the secondary radiation of approximately the same intensity as in the case of the fermentative process.

The full details of our results will be communicated elsewhere.

E. G. PROKOFIEWA.
Institute for Experimental Medicine,
Leningrad.
Aug. 20.

[1] "L'Analyse mitogénétique spectrale". Paris: Hermann et Cie., 1934.

Bird Migration and the Red Sea

THAT change of temperature has little to do with bird migration is well illustrated by the fact that flocks, apparently of ducks, are seen as early as the middle of August, moving south past the Biological Station of the University of Egypt at Ghardaqa just south of the entrance to the Gulf of Suez. Not only are they beginning their migration when it is warmest in the north, but also, a few days after passing here, they enter the hot part of the Red Sea, where, in August, conditions are truly dreadful from the human point of view.

I write in order to point out the excellent position of this Station for observation on this fascinating subject. The Red Sea is evidently a main route, and appearances suggest that at this point two lines cross, a north to south-west line via Sinai and the Nile, and the main line north-west to south-east along the Red Sea coast. I have neither the leisure nor qualifications for making adequate notes, but no one can see this wonderful sight without wishing that regular and detailed observations should be made.

C. CROSSLAND.
Marine Biological Station,
Ghardaqa.
Aug. 27.

Ionic Product of Heavy Water

A PRELIMINARY determination of the dissociation of heavy water, by measurement of the electromotive force of cells containing pure deuterium electrodes in solutions of KOD and DCl in heavy water containing 95·5 per cent D_2O, has given the result that K_W for D_2O is of the order of one third the ionic product for ordinary water, at the same total ionic strength (0·1 and 0·05). It is proposed now to use the same method for an accurate determination.

B. TOPLEY.
W. F. K. WYNNE-JONES.
Frick Chemical Laboratory,
Princeton.
Aug. 18.

Research Items

Metal Images from Southern India. Mr. T. B. Nayar has recently published (*J. Annamalai Univ.*, **3**, No. 1) an account with illustrations of three metal images from a Śaivite shrine, called Pāśupetēśwarar Kovil, at Tiruvēṭkaḷam, South Arcot, Madras. The images are said to have been excavated from a mound a few yards southward of the present shrine within the memory of the great-grandmother of the present hereditary priest. Local tradition credits the place with Arjuna's penance, and an annual festival is celebrated here for two days in the month of May–June. The chief interest of the festival is a fight between men dressed as hunters and men dressed as Arjuna. The festival, however, is of recent growth and not more than twenty-seven years old. The first of the three metal images is that of Kirātārjunamūrti, that is, Siva as he appeared to Arjuna in the story of Arjuna's penance. Representations of the penance are rare in art and few images of Siva in this manifestation, either in stone or metal, are in existence. The image here described is 23·2 in. high and is made of copper, cast solid by the cire perdue process. The figure wears the sacred thread and a loin-cloth tightly wrapped and kept in position by a decorated belt or girdle. Its arrangement is unique in South Indian metal figures. The figure stands with the weight on the left leg, the right arm raised at right angles, holding the arrow, the left arm being raised vertically from the plane of the shoulder as if holding the top of a bow. An oval ring fringed with tongues of flame surrounds the image. When excavated, this figure had the figure of Arjuna on its left and a broken image of Indra on its right, both engaged in sockets. If this statement be correct, the image of Indra is difficult to explain. Verification is not possible, as the figure was destroyed for its metal. The arrangement is not known in any other South Indian examples. The figure of Arjuna wears no thread, and the loin-cloth is kept in position by three bands, below which is an arrangement of two sashes, characteristic in certain sculptures.

Shamanism in North America. In a study of shamanism in North American society by Mr. Leonard L. Leh (*Univ. Colorado Studies*, **21**, No. 1), the position and functions of the shaman are surveyed in each of the regional areas of Amerindian culture in turn. The shaman in some form existed throughout North American society, notwithstanding the great variety of cultures. It was not, however, everywhere the same thing. The background is the supernatural world which the Indians believed to control their destinies. In some tribes, the guardian spirit concept was sufficient to explain all the powers of the shaman, as, for example, among the Eskimo, the Algonkin and the Plains Indians. Among the Eskimo, Tlingit and others the shaman might have a number of such guardian spirits. In part of the Californian area, however, this idea was poorly developed, or absent. In addition, the shaman might have to be trained by other shamans, or undergo a period of preparation as an additional qualification to the vision in which the spirit appeared to him. He might become a shaman by initiation—a method developed to a high degree among the Central Algonkin. In general, both men and women might become shamans, though in the south-west it was not often that a woman took on the full burden of shamanistic powers. There was throughout a marked tendency for shamanism to run in families: but over a large part of the continent there was no restriction to prevent anyone becoming a shaman. The function of the shaman was to compel the supernatural powers to serve human needs, healing the sick being the most common. The shamans were also capable of causing sickness. Not all the various functions of a shaman were performed by all the shamans in a tribe. There were specialists—prophets, seers, rain-makers and so forth. Originally the shaman does not appear to have been a public functionary, but the tendency was for the shaman to become socialised, with a quasi-public position, and later for them to form an organisation.

Madras Fisheries. The administrative report for the year 1932–33 by the director, Dr. B. Sundara Raj, describes the activities of the Department, which include research in marine fisheries, minor marine and estuarine fisheries of prawns and edible oysters, inland fisheries, fish breeding, pearl and chank fisheries, with inspections, besides a large amount of miscellaneous work. There are three biological research stations, at West Hill, Krusadai and Ennur. Great possibilities for pond- and well-culture in rural areas are shown but there is a need for more research with regard to the fish for them. It is hoped that a fresh-water biological station and central fish farm for research will soon materialise. There is also a scheme for the establishment of a technical laboratory for research in fish manures, fish oil and fish meal. A specially important part of the report deals with the chank fishery. Little is known of the biology of the chank, *Turbinella pyrum*. Extensive marking experiments have been made which, it is hoped, will throw much light on the rate of growth, mortality and migrations; also researches on its breeding habits. Large egg capsules, measuring 7–10 in. and containing 30–33 chambers, are laid with one end fixed in the ground, where about the first nine chambers are empty; in the others, young chanks were found, two to each chamber. The veliger stage is passed within the chamber, the embryonic shell having a conical transparent shell of four to six whorls and the velum having four lobes. When ready to hatch, the shell has quite a different form, is 9–10 mm. long and has lost the velum.

Ciliates from Bermuda Sea Urchins. Miriam S. Lucas has recorded (*J. Roy. Micro. Soc.*, **54**, 1934) observations on ciliates of the genus *Metopus* which occur in the intestinal cæca of sea urchins from Bermuda. Practically all the sea urchins (*Diadema setosum*) contained *Metopus circumlabens*, and a second and new species occurs sparingly in some of the urchins. The ciliates are commensals, feeding on diatoms, fragments of algæ and cellular debris in the host's intestine. Particular attention was devoted to the neuromotor system, which consists of the peristomal membranelles of the lower lip, the motorium, the ventral and dorsal adoral fibres, the pharyngeal strand and the peripheral cilia. The motorium is a centre whence various peristomal fibres arise and lies deeply imbedded in the cytoplasm posterior to the cytostome. It is highly chromophilic, staining deeply with fuchsin in Mallory's triple stain. The pharyngeal strand appears to be very striking in this ciliate, arising from the

motorium and passing posteriorly to the right of the cytopharynx into the hinder part of the animal where it forms a large spiral coil. This strand is fibrillar and the author is disposed to regard the neuromotor system as bearing "a specialised relationship to the ingestatory cilia and to the cytoplasmic mass of the cell including the digestive, absorptive and excretory organelles". Observation of fission stages indicates that the neuromotor fibres arise as outgrowths from a clump of specialised posterior basal granules of the membranelle zone (the future motorium ?).

Anthozoa of the North Sea and Baltic. Included in Part 26 of "Die Tierwelt der Nord- und Ostsee" (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1934. 17.60 gold marks) is the systematic account by Ferdinand Pax of the Anthozoa, namely, the Ceriantharia, Antipatharia, Zoantharia and Madreporaria. The last group is represented in these northern seas by five genera, three of which are solitary corals—*Flabellum*, *Caryophyllia* and *Paracyathus*, and two, *Lophohelia* and *Amphihelia*, are colonial. All are represented by single species except *Paracyathus*, of which three species occur in the area. The anatomy and biology are concisely described and notes are added on the habitat and geographical distribution of the species. In a postscript, we are informed that the names *Lophohelia* and *Amphihelia* (both due to Milne Edwards and Haime, 1857) should be replaced by *Lophelia* and *Amphelia* respectively as these have priority, having been used by Milne Edwards and Haime in 1849.

Fireblight of Pears and other Plants. Dr. K. M. Curtis, chief of the Mycology Department of the Cawthron Institute, has prepared a useful synopsis of present-day knowledge of the destructive disease known as fireblight (Mycology Pub., No. 10, Cawthron Institute, Nelson, New Zealand. Reprinted from *Orchardist of New Zealand*, June 1, 1934). Fireblight attacks apple, pear, hawthorn, quince, medlar, loquat and *Pyracantha angustifolia*. It is caused by *Bacillus amylovorus*. Symptoms of the malady are a brown discoloration of the affected parts, wilting and discoloration of the blossoms and leaves, and a slowly advancing canker of the main branches and trunk. The bacillus travels along the soft tissues of the plant, but overwinters in the cankered branches and larger twigs. Insects and birds transmit the organism from tree to tree, whilst pruning or grafting and even showers of rain can disseminate the disease. The bacillus gains entrance to the plant through wounds or through the stomata. Control measures are the removal of infected parts six inches below the lowest canker, and the treatment of the cut surface with acid mercuric chloride solution. A slight amount of control was obtained by spraying the open blossoms with weak Bordeaux fungicide.

Treatment of Lawns. The North of Scotland College of Agriculture has recently published a booklet entitled "Experiments on Lawns" by Mr. W. M. Findlay (reprinted from the *Scottish Journal of Agriculture*, 17, No. 2, April 1934). The suitability of various mixtures of lawn grasses is discussed, and a seeding of $\frac{1}{3}$–$\frac{1}{2}$ oz. per square yard of New Zealand bent grass, or a mixture of $\frac{3}{4}$ oz. of New Zealand bent and $\frac{1}{4}$ oz. Chewing's fescue per square yard is recommended. Manurial trials have also been carried out, and sulphate of ammonia has been found to be the best form of nitrogen. It stimulates the turf, and kills most weeds. Superphosphate and sulphate of iron have also a beneficial effect in eradicating weeds. It is suggested that two dressings of sulphate of ammonia be given in spring, and two in autumn, both at the rate of 1 oz. per square yard. Half an ounce of sulphate of iron may be applied in spring, and 1 oz. superphosphate per square yard in the autumn. There is general agreement of these results with others on the manuring of lawns, notably with those obtained by the Golf Green Research Station, Bingley, Yorks.

Dhubri Earthquake of July 3, 1930. A valuable report on this earthquake has been written by Mr. E. R. Gee (*Mem. India Geol. Surv.*, 65, pt. 1, 1–106, 1934). The earthquake is interesting from its possible connexion with the great Assam earthquake of June 12, 1897. From observations in the field, it appears that the earthquake originated in the strata that underlie the alluvium of the Brahmaputra River, a few miles to the south of Dhubri, in lat. 25° 57′ N., long. 90° 0′ E. This point, the position of which agrees closely with that indicated by the seismographic records, lies close to the north-west boundary of the epicentral area of the Assam earthquake, as laid down by Mr. Oldham. The intensity of the shock was far less than that of the Assam earthquake, for in no place did it exceed degree 9 of the Rossi-Forel scale. At Dhubri, however, a single determination of the maximum horizontal acceleration showed that it was not less than 2,200 mm. per sec., or about the same as that at Messina in 1908 and San Franciso in 1906. The area disturbed was probably about 322,000 sq. miles, or about the same as that of the Mino-Owari earthquake of 1891, and about double that of the Kwanto earthquake of 1923. The number of after-shocks, though large, was by no means unusual, and they declined in frequency very rapidly, the numbers felt in July, August and September 1930 being 223, 35 and 17, and, in the three years succeeding the earthquake, 294, 35 and 68, or altogether 397.

Cold-Working of Copper. A recent paper by W. A. Wood, of the National Physical Laboratory, deals with the lattice distortion due to cold-working of copper (*Phil. Mag.*, Sept.). Copper strip was annealed and then rolled, specimens being examined at various stages in a specially constructed X-ray diffraction camera. The negatives were measured on a microphotometer. The lines due to reflection by the (420) lattice phases of the crystal were broadened and also displaced in a way corresponding to an increase in the average spacing of the planes. This increase in the lattice spacing corresponds to an increase in latent energy, which may be estimated by comparing it with the energy absorbed by the lattice in thermal expansion. The maximum distortion observed corresponds to an increase in energy of the order 1·7 cal. per gm. This magnitude is comparable to that obtained by direct measurement in the case of copper under torsion.

Quantitative Study of Pleochroic Haloes. G. H. Henderson, with S. Bateson and L. G. Turnbull, has recently described quantitative measurements of the blackening in pleochroic haloes in mica (*Proc. Roy. Soc.*, A, July). The haloes were examined directly in a specially constructed recording photoelectric photometer, and a number of curves are given showing the darkening at each point of the halo. These curves

show humps corresponding very clearly to the dark rings in the haloes. A specimen of the mica was artificially blackened by exposure to radium emanation and a 'characteristic curve', including the phenomenon of reversal, was obtained. It is then shown that the darkening in the haloes may be calculated on the assumption that the 'effective exposure' produced along an α-particle track is proportional to the ionisation produced along the corresponding part of a track in air, the blackening produced being calculated from the 'exposure' by use of the characteristic curve. The method has been applied to several biotites. In some biotites, rings due to actinium products are found, and it is shown that the relative intensity of these rings and the uranium series rings gives values for the ages of the minerals which are in tolerable agreement with other estimates.

A New Multiple-Electrode Thermionic Valve. The now common supersonic heterodyne type of wireless receiver involves the use of a frequency changing stage, which, until comparatively recently, included two valves. One valve operated as an oscillator, and its output was applied with the incoming signal to the second valve, which functioned as a detector producing oscillations of an intermediate frequency for subsequent amplification. Progress in the technique of valve design and construction led to the combination of these two valves in one envelope; first, as a pentode frequency changer, and later, when additional electrodes were required for volume control purposes, the heptode and octode were developed. Such valves have previously operated with all the electrodes lying in a single electron stream, and this gives rise to interaction between the signal-frequency and oscillator circuits, which is very undesirable, particularly in short-wave reception. In the *Wireless World* of October 5, an article by E. E. Shelton describes a new valve, which is claimed to be free from faults of this type. This new frequency changer consists of two separate valves constructed in a single envelope. These two valves, one a triode and the other a hexode, operate with separate electron streams although the emission for these is obtained from a common cathode. The triode is employed as the oscillation generator, and its grid is directly connected to the appropriate grid of the hexode, which receives the incoming signal at controllable intensity and rectifies the combination of the two sets of oscillations. Owing to the fact that two screen grids of the hexode are connected together internally, the valve is provided with the conventional seven-pin base, with an additional electrode at the top for the control grid, which is connected to the signal circuit. The advantages claimed for this new valve over other frequency changers are that, while it is non-radiating and can be employed with an automatic volume-control system, it gives complete freedom from interaction between the signal and oscillator frequency circuits, and also a lower level of background hiss. These points are important in normal broadcast reception, but they are doubly so on short wave-lengths.

d-Sorbitol. The rare sugar alcohol *d*-sorbitol has been found by H. H. Strain (*J. Amer. Chem. Soc.*, **56**, 1756; 1934) to occur in large quantities in the so-called Toyon berries, the fruits of *Photinia arbutifolia*, Lindl., from which it may be isolated by extracting with hot water, filtering through charcoal and siliceous earth, fermenting with yeast, evaporation under reduced pressure and extraction with alcohol. Another process depending on crystallisation from pyridine was also used. The properties of the purified *d*-sorbitol (m.p. 89°–93°; specific rotations) and some derivatives (triacetone-sorbitol, triformal-sorbitol, benzal-sorbitol and sorbitol hexa-acetate) are described. Sorbitol forms crystals containing one molecule of pyridine; this compound and triacetone-sorbitol are easily converted into triformal-sorbitol, and this reaction provides a ready means for the identification of *d*-sorbitol and many of its derivatives.

Molecular Weights of Red Blood Proteins. The red blood protein, to which the old name erythrocruorin has been applied by Svedberg, exists in several different modifications characterised by different molecular weights as determined by the ultra-centrifuge method (cf. Svedberg and Hedenius, NATURE, **131**, 325; 1933). T. Svedberg and I. B. Eriksson-Quensel (*J. Amer. Chem. Soc.*, **56**, 1700; 1934) now report investigations on the erythrocruorins from *Planorbis corneus*, *Daphnia pulex*, *Petromyzon fluviatilis*, *Arca pexata*, *Notomastus latericius*, *Chironomus plumosus*, *Thyone briareus* and *Myxine glutinosa*. These red respiratory proteins form, together with hæmoglobin (which is strictly limited to the five higher classes of the vertebrates), a system of molecules built up of units of weight 34,500 and half this value in simple multiple proportions. In some cases, mixtures of molecules are present. The observed molecular weights range as high as above three million, corresponding with 192 hæmin groups, and the multiples of the unit ($\frac{1}{2} \times 34,500$) found by the sedimentation method are 1, 2, 4, 24, 96 and 192; the multiples 8, 16 and 48, not determined for red pigments, are known from measurements on other proteins.

Dimensions of the Galactic System. The apparent disparity between our galaxy and the Andromeda nebula (which is the largest known external galaxy) has long been a problem requiring explanation. The theory of galactic rotation gives an independent method of computing the size of our galaxy, and Drs. J. S. Plaskett and J. A Pearce, using this method, have now given evidence that the disparity is not real (*Mon. Not. Roy. Astro. Soc.*, **94**, 680; 1934). They have used the radial velocities and proper motions of *O*5 to *B*7 stars alone, in order to obtain homogeneous material from stars at distances as great as possible. They find the centre of the galaxy to be 10,000 parsecs from the sun, and its diameter 30,000 parsecs, values agreeing with Shapley's, if the latter are corrected for the absorption of light in space. The diameter is thus only 2·5 times that assumed for the Andromeda nebula, while independent investigations by Hubble and by Stebbins have shown that this assumed value is probably too small, and should be about 30,000 parsecs—thus completely removing the above-mentioned difficulty. Incidentally, the problem of the well-known '*K* term' in the radial velocities is also solved in the course of the above investigation. Where corrected for galactic rotation and (in the southern hemisphere) for stream motion of the *B*-type stars, this *K* term is reduced to 1·1 km./sec., a quantity which can then be explained by the Einstein gravitational displacement of spectral lines towards the red without assuming unduly large masses or densities.

Colloidal Electrolytes

THE general discussion on colloidal electrolytes, organised by the Colloid Committee of the Faraday Society, took place at University College, London, on September 27–29. The meeting was well attended and a number of eminent foreign chemists were present as guests. This was the first general discussion organised by the Society that has ever been held at a London college. University College may for two special reasons be regarded as a happy choice of meeting place since in the first place Prof. F. G. Donnan (in the absence of the president of the Society) was chairman, and in the second place Thomas Graham carried out much of his pioneer work there. A more mundane reason for congratulating the Society on its arrangements was the success which attended them. The close proximity of lecture room, rest room and an excellent refectory reduced physical fatigue to a minimum and allowed the protagonists to expend all their energy in coping with intellectual problems.

The programme of the discussions was divided into Part I, General, (*a*) Theory, (*b*) Methods and Experimental Technique, and Part II, Special and Technical, (*a*) Soaps and other Long-Chain Colloidal Electrolytes, (*b*) Dyestuffs, (*c*) Silicates and Silicic Acid, (*d*) Proteins, (*e*) Other Substances. Prof. H. Freundlich (London) opened the meeting with a general introduction on the nature of colloidal electrolytes and their importance for colloid science. He pointed out that colloidal electrolytes can to-day be prepared in many cases as pure substances. As a class they are characterised by the fact that they form ions of colloidal size spontaneously. They can be classified into three types, those with ionic micelles sensible to dilution forming small dialysable ions; those with ionic micelles sensible to dilution but forming non-dialysable ions; and those not influenced by dilution. In the case of the proteins, their amphoteric nature gives them certain special properties.

The discussion on general theory, which followed, illustrated once again how mankind can be divided into two classes—those who think in terms of three dimensions and those who think in terms of mathematical abstractions. The former, among whom Prof. H. R. Kruyt (Utrecht) and Prof. A. J. Rabinovich (Moscow) may be mentioned, warned the meeting against being over-impulsive in extending to systems containing large ions of colloidal dimensions general equations such as those of the Debye-Hückel theory, which had been worked out for systems containing only the small ions of the ordinary dialysable electrolyte. Nothing daunted, however, Prof. Donnan (London), with the support of Dr. G. S. Hartley (London), Dr. C. Robinson (London) and others, by adding new factors to their equations and extending in this way their range of operations, organised a charge of mathematicians on to the field and engaged in what looked like a winning battle. Extrapolation from molecular dimensions to colloidal dimensions is, after all, no more dangerous than extrapolation from extended surfaces to colloidal dimensions.

An excursion from the main battle turned up in a lively discussion as to whether a charged colloidal particle were more profitably regarded as a large colloidal ion surrounded by small *gegenions* or as a large colloidal particle surrounded by an electrical double layer. Prof. E. K. Rideal (Cambridge) dealt with the problem in the detached manner of a judge, but unlike most judges produced experimental evidence in support of his opinions. Prof. Kruyt (Utrecht) pointed out with considerable effect that paraffin and water make an electrical double layer without the intervention of any ions, and suggested that the influence of oriented dipoles should be considered. This was immediately responded to by Dr. N. K. Adam (London), who stated that the ε-potential could be built up by dipoles but the ζ-potential could not. It is interesting to note that, on a later occasion, Mrs. Laing-McBain described the ζ-potential as "rather mythical"—to the consternation of some but the comfort of others.

The meeting was brought back to earth or, in other words, to the realm of experimental science, by the papers of Prof. A. Frumkin and Dr. Proskurnin (Moscow), Mr. G. S. Adair and Mrs. Adair (Cambridge) and Dr. H. B. Oakley (London) on new developments in experimental methods.

In the special sections, the discussion on the soaps turned rather round the criticism made by Mrs. Laing-McBain that the electro-kinetic theory of soap solutions had unfortunately grown up apart from the electrolytic theory of ions; the two theories, however, could be brought together. The properties of soap curds and solid soaps and the mechanism of the sudden change which a critical temperature provokes in a soap solution received attention. While some speakers attributed this to a change in the properties of the solution, others favoured a change in the properties of the solid soap. Dr. Adam (London) showed that ionic effects and an influence on the cohesion of the long hydrocarbon chains are both involved.

The discussion on dyestuffs was the most animated of the whole meeting, and the interest betrayed is a measure of the great progress which has been made in recent years in the colloidal chemistry of these substances. Prof. E. Elöd (Karlsrühe) started the ball rolling by a paper discussing the reaction between protein fibres and substantive dyestuffs and Messrs. Valkó (Ludwigshafen), Robinson (London), Moreton (Braintree) and Hartley (London) ranged the discussion round the problem of the size and state of aggregation of the dye particle, the influence of dissolved salts on this and on the factor introduced by the size of pore in the material being penetrated by the dye. In the complete absence of salts, dyeing does not occur, and this was generally attributed to the aggregated state of the dye particles preventing diffusion, though an alternative suggestion that the salt influences the properties of the ultrafilter was also put forward.

A short discussion on silica was launched by Prof. Rabinovich (Moscow) and Prof. W. D. Treadwell (Zurich). The latter described the complicated changes occurring in silica gels on standing due to the polymerisation of the silica molecules.

The discussion on the proteins was opened by Dr. D. Jordan Lloyd (London) who indicated that the properties of this class of colloidal electrolytes are influenced by three special features, the static nature of the ionic equilibrium where *zwitterions* are concerned, the special capacity of the hydrogen ion to influence this equilibrium on account of its power of forming co-ordinated links with both acid and basic

groups, and the power of large multivalent *gegenions* to form compounds of greater stability with proteins than small mono- or di-valent *gegenions*. To these Prof. Rideal (Cambridge) added a fourth in the power of proteins to form co-ordination complexes with dipole molecules of the type of thiourea. The discussion centred largely on titration curves, and Dr. R. K. Schofield (Harpenden) brought forward a valuable new technique based on the use of metaphosphoric acid. Prof. E. J. Bigwood (Brussels) dealt with diffusion in gelatin gels and came in for some friendly criticism at the hands of Mr. E. Hatschek (London). Dr. E. B. R. Prideaux (Nottingham) dealt with diffusion potentials of protein ions and Prof. T. Weigert (Leipzig) with colloidal electrolytes in photographic emulsions. Prof. E. Hammarsten (Stockholm) and his colleagues pursued the chemistry of the proteins into the chromosomes—to the satisfaction of Dr. Dorothy Wrinch (Oxford), who has worked out the electric behaviour of these bodies. Two papers by Prof. K. Linderstrøm-Lang (Copenhagen), in the absence of the author, were taken as read and the same fate unfortunately fell to the contributions on colloidal carbohydrates from Profs. A. Lottermoser (Dresden) and M. Samec̆ (Ljubljana). The meeting was brought to an end by a paper on tungsten sols contributed by Dr. F. Eirich (Vienna).

A brief notice cannot do justice to the thirty-seven official papers given at the meeting or to the ensuing discussions, but the full printed report will be issued by the Faraday Society on January 1, 1935.

D. J. L.

Economic Problems of Technological Progress

IN a contribution to the discussion on "The Need for a Technique of Economic Change" arranged by the Department of Industrial Co-operation of Section F (Economic Science and Statistics) at the Aberdeen meeting of the British Association, Mr. N. F. Hall examined the more specifically economic problems which arise as a consequence of technological improvements. Economics, like other sciences, he pointed out, has in the past made progress by adopting the well-tried method of limiting the number of variables in any problem under review. The necessity for the limitation of variables has resulted in the development of the idea of the 'Stationary State', which has been the most fruitful abstraction for purposes of economic analysis. As soon, however, as one or more of our hypothetical constants becomes a variable, the stimulus of a change in population or increasing technological knowledge alters our simple stationary State into a dynamic system.

The technique of economic change is therefore the accurate interpretation of changes in relative prices under dynamic conditions. Among such changes are those associated with developments in scientific knowledge, which make possible new methods of production and lead either to the output of entirely new goods or to the better fabrication of old ones, or to both things concurrently. This sort of technological change gives rise to numerous economic disturbances, such as the problem of obsolescence or the territorial regrouping of industries. Limiting the subject, however, for the present purpose to the economic difficulties which arise in securing the orderly development of the new processes rather than in the decent burial of the old, we are confronted with a special case of the general problem of 'uncertainty'. The economist has learned in the last decade to distinguish between those incidents in economic life which are called risks and those which he now defines as 'uncertainties'. A risk such as that of shipwreck or fire is a recurrent circumstance and consequently capable of quantitative measurement and actuarial treatment. Uncertainties, however, are unpredictable and incapable of quantitative measurement; they arise out of the freedom of the mind and the continual possibility of change in human tastes and human knowledge. They reflect in brief the difference between the hypothetical stationary State of simpler economic theory and the real world.

The necessity for specialisation introduces the element of 'true' uncertainty and a specialised economy can only be, in a very limited sense, a competitive one. The greater the degree of specialisation, the larger will be the zone of uncertainty, as the obstacles in the way of adjustment and re-adjustment will increase as specialisation continues. Here then is the economic problem which is created by every forward step in scientific and in technological knowledge. The utilisation of advancing knowledge in the service of society demands an ever-increasing specialisation both of the men and of the capital goods with which they co-operate. The more both plant and labour are specialised, the greater the difficulties of bringing about further changes, particularly when these changes are on so large a scale that they require a more extensive re-distribution of both men and plant than can be secured by a wise direction of new entrants into industry or by far-seeing investment of new savings. The need for a technique of economic change arises because the benefit of further developments in scientific knowledge would be lost unless in the economic sphere the rigidity which specialisation necessarily brings with it can be overcome.

In the past, neglect of the price problems set up by uncertainty in connexion with the task of introducing new plant and new processes has been a cause of many difficulties. The inherent tendency in free as in 'planned' economic systems to over-develop the new thing seems in large part to arise from a misunderstanding of the way in which these zones of uncertainty, arising out of technological change, influence the price system, so that the economic danger signals given by price changes are either disregarded or entirely ignored. Confusion arises because changes in the prices of, and the economic return upon, new fixed plant—which are the result of changes in the element of uncertainty—are mistakenly considered to represent a permanent shift in the nature of the demand for the particular plant and its products.

Nearly all proposals for monetary manipulation seem to be open to the fatal objection that they are built upon the assumption that there is little or no change in technological processes and that uncertainty is absent. The result is that they cannot be made to apply to 'real' conditions. Proposals for arbitrary alterations in the supply of legal tender money will also fail to achieve the objectives of stabilising the price level or of providing a quantity

of purchasing power "sufficient to carry off the whole potential product of modern industrial plant", because this stream of purchasing power—however it might be injected into the system—has an influence upon the general price level and upon the volume of economic activities, which varies with the degree of uncertainty present. It is necessary rather to look to improvements in the methods employed in financing new processes as the first practical step in the development of a technique of economic change.

Changes in uncertainty lead to extensive variations in capital values and in the prices of capital goods. The objective must be to isolate the economic effects of these price shifts to prevent them causing either over-investment in new processes or general Stock Exchange disturbances. Existing financial institutions in their own interest might agree that they would not themselves finance directly the development of any new process but would pool a limited quantity of their resources to form a special holding company, which would itself finance the necessary number of unit companies to try out a new process or processes. The knowledge that such a pool existed should deter the private investor from walking into a field which is already undergoing professional development, and the Stock Exchange might be prevailed upon not to give facilities to competing new issues. Financial interests would lose some of their spectacular profits, but their business would become more stabilised and less subject to violent fluctuation than in the past. Once the method had been fairly tried and tested, there would soon be felt a need for closer co-operation between financial interests and technological research, as well as for a centralisation of part of the economic intelligence services of finance.

Scottish Fisheries in 1933*

According to the annual report of the Fishery Board for Scotland, both the white-fish and herring fishing branches of the Scottish fishing industry gave cause for anxiety during 1933, and, while the prospects of the former afterwards improved, those of the latter steadily deteriorated. The fishing industry as a whole continued to suffer from the effects of the world-wide economic depression, and the herring industry has proved specially vulnerable, owing to the preponderating degree to which it is dependent on overseas markets.

The white-fish fisheries yielded actually a catch lighter by some 4 per cent than in 1932, and the lowest aggregate value for any post-War year; but the decline in the average price per cwt. which had been in progress for a number of years was arrested, the average for 1933 being 17*s*. 9*d*. as against 17*s*. 4*d*. in 1932. In very many cases, operations were being conducted on an unremunerative basis, and new construction, even to replace vessels lost, had therefore been suspended. This was believed to be largely due—apart from the effects of the general depression —to unregulated competition, partly owing to the large foreign landings and imports, and partly to failure to maintain a proper standard of quality and size in much of the fish marketed; and a comprehensive policy to deal with the situation was embodied in the Sea-Fishing Industry Act, 1933.

It was hoped that the imposition of minimum sizes for fresh fish exposed for sale, with its corollary of minimum mesh, would not only ensure better prices, but tend also to conserve stocks, and lead ultimately to a marked improvement in both the quality and value of landings; that the closing of the distant northern grounds for the four warmest months of the year would prevent excessive supplies of fish which, under present conditions, are necessarily of inferior quality when landed and tend seriously to depress the market; and that the regulation of imports would check competition that seemed to threaten the existence of the British industry.

Owing to the variety of factors operative, including the 10 per cent import duty imposed in 1932, and the adverse exchange as affecting German fishermen in particular, as well as normal fluctuations in the fisheries and changing economic conditions, it did not prove possible up to the end of the year to appraise with certainty the effects of this new legislation. It seemed clear, however, that it would be of benefit to fishermen and vessel owners, and this general impression has been confirmed by later experience. The new legislation is approved by the trawling section of the industry, but some dissatisfaction has been expressed by fish merchants and export curers at the curtailment of supplies necessarily involved, and also by some inshore fishermen.

No further large fishing units have yet been constructed for use in Scotland as a result of the improvement in returns; but steady progress is being made in the construction of medium-sized motor-boats for white-fish fishing, especially seining in the Moray Firth area, which is doubtless encouraged by the assurance of better markets.

Herring fishing was conducted under conditions which almost precluded any possibility of general success. The development of the summer fishing was delayed until beyond the middle of June by a dispute regarding the discount allowed by fish salesmen on curers' purchases of herrings; and when a settlement was reached, catches during what is normally the main part of the season were so light that, although prices rose to an uneconomic level for curers, fishermen failed to earn sufficient to cover working expenses. A heavier fishing unexpectedly experienced in August retrieved to some extent the position of fishermen, but a break in the Continental prices for cured herrings consequent on the increase in supplies adversely affected curers and other firms engaged in the distribution of cured herrings.

The principal markets for cured herrings, in order of importance, were Germany, Poland (with Danzig), Latvia and the United States. Several attempts were made during the year to dispose in the home markets of pickled herrings put up in small containers, and herrings prepared in various new ways usually involving smoking, but in no case so far with any outstanding success.

The encroachment of trawlers on Scottish inshore waters, particularly on the west coast, caused much concern during the year, and the Board found it necessary to submit proposals for the strengthening of its patrol fleet, and at the same time a Government Bill, since passed, was introduced increasing the penalties for illegal fishing.

* Fishery Board for Scotland, Fifty-second Report, for the year 1933. (Edinburgh and London: H.M. Stationery Office, 1934.) 1*s*. 6*d*. net.

University and Educational Intelligence

AT the beginning of November, Loughborough College will inaugurate a series of intensive management courses under the direction of Mr. E. T. Elbourne. Each of the eleven courses will last ten days. Lectures will follow in the main the sectional syllabuses of the Institute of Industrial Administration's diploma, and subscribers to any course may, on completion, sit for the Institute's examination accordingly. The tuition fee for any ten-day course is five guineas, including the loan of books and demonstration materials. Further information can be obtained from the Registrar, Loughborough College, Loughborough, Leics.

A NEW high-voltage laboratory at East London College enables that institution to offer greatly improved facilities for study and research in a branch of electrical engineering, the practical importance of which at the present time is obvious. Towards the cost of its erection and equipment the Court of the University made a grant of £12,000 and the Drapers' Company gave £5,000 and lent another £5,000 to enable the College to proceed at once with this and other enterprises. The calendar for the present session announces that the equipment will include a 500,000-volt testing transformer, a surge generator with a maximum capacity of a million volts, a direct-current generator of 200,000 volts capacity, a cathode ray oscillograph recording surge voltages up to a million volts, Schering bridge for measurement of dielectric losses, and transformers of 30,000–250,000 volts capacity for experiments. A course in high-voltage technology for degree students is being introduced under the direction of Prof. J. T. MacGregor-Morris.

A REVIEW of the school year 1933–34 in the United States is published in the June issue of *School Life*. Dr. G. F. Zook, who assumed the office of Commissioner in June 1933, has now relinquished it to become director of the American Council on Education and has been succeeded by Mr. J. W. Studebaker, who for the past twenty years has been superintendent of public schools in Des Moines, Iowa. The year is characterised in an editorial as one of sensational progress in the following respects: the Federal Government did more for schools than in any year since 1787; State support for public education came into being in many States; adult education classes attracted more than a million students; nursery schools increased from 300 to 2,500; practical camp schools were set up for 300,000 boys in "civilian conservation camps"; and industrial child labour was ruled out. As regards the last point, the retiring Commissioner points out that the prohibition (by two thirds of the codes) of the employment of 'under-sixteens' means that millions of young people have little or no opportunity of regular employment. Either the industries must co-operate, he says, in setting up extensive apprenticeship programmes including part-time instruction, or the Government will have to adapt the civilian conservation camps to enable them to reach a larger proportion of the adolescent population, or the school system must provide types of training that will appeal to all who do not go on to a university. It may be noted that, on June 27, President Roosevelt made the Secretary of Labour an educational dictator for industry.

Science News a Century Ago

Faraday's Experiments on Self-Induction

In 1834, a young man, Mr. William Jenkin, brought to Faraday's notice a new effect of electro-magnetic induction. The shock obtained on breaking contact with a voltaic battery was greatly enhanced if a coil instead of a straight wire was used as the conducting circuit. On October 15, 1834, Faraday began experiments on this action of the 'extra current', as he called it, and traced it to induction between the neighbouring turns of the coil at the moment of disjunction. "These effects," he wrote in his Diary a month later, "show that every part of an electric current is acting by induction on the neighbouring parts of the same current, even in the *same wire* and the *same part* of the wire."

The Ninth Series of the Experimental Researches in Electricity contains a description of these experiments on self-induction. The action had interesting consequences, as for example, if a wire was doubled and formed into a coil, the induction in one half neutralised that in the other, and a non-inductive coil resulted.

It is of this occasion that Faraday said, years afterwards: "The number of suggestions, hints for discovery, and propositions of various kind offered to me very freely, and with perfect goodwill and simplicity on the part of the proposers for my exclusive investigation and final honour, is remarkably great, and it is no less remarkable that but for one exception—that of Mr. Jenkin—they have all been worthless".

Sturgeon's Electro-Magnetical Experiments

On October 15, 1834, William Sturgeon sent to the editors of the *Philosophical Magazine*, then conducted by Sir David Brewster, Richard Taylor and Richard Phillips, an "Account of some Electro-magnetical Experiments made with the Large Magnet at the Exhibition Room, Adelaide Street". The experiments, he said, were made by the permission of the proprietors of the Exhibition Room, and he acknowledged the obligations he was under to Mr. Payne, who procured the use of the magnet, and to Mr. Maugham, the chemical lecturer, for his assistance. Among the results of his experiments, Sturgeon mentioned the decomposition of "hydriodate of potassa" in solution and the decomposition of sulphate of copper and of water. "The experiments were made by changing the connexions and reversing the current, and the results were exhibited with as much promptitude as they would have been by the employment of a voltaic battery. . . . I have also made a great variety of electro-magnetic rotations, and some other rather novel motions, with electric currents by magnetic excitation, which I intend to publish as soon as opportunity offers."

The Gresham Chair of Physic

The death of Dr. Christopher Stanger in September 1834 had left vacant the professorship of physic in Gresham College. In connexion with this, the *Times* on October 18, 1834, said: "We understand that the place of Lecturer in Physic in the Gresham Institution is now vacant and that it is shortly to be filled up. Contrary to the intentions of the enlightened founder, the lectureships in this institution have been for a lengthened period mere sinecures. We hope, however,

that advantage will be taken of the present opportunity to pave the way for a better system, by the appointment of at least one competent and efficient teacher. All favouritism ought in a case of this sort to be, as we have no doubt it will be, entirely laid aside, and the situation should be given to the candidate who produces the least unequivocal proofs of industry learning and talent".

Iron Shipbuilding

Among the pioneers of iron shipbuilding was Sir William Fairbairn (1789–1874) who, in 1835, opened a shipbuilding yard at Millwall on the Thames. Prior to this, however, he constructed several iron vessels at Manchester. These were built in sections, taken to pieces and reconstructed at the ports. On October 18, 1834, the *Mechanics' Magazine* said that an iron steamer of 96 tons of Fairbairn's was launched at Selby. As she was for Swiss owners, the vessel was to be navigated up the Rhine as far as possible, taken to pieces again, carried overland a distance of forty miles and ultimately launched at Zurich, "and after all this will be considerably cheaper and better than if built on the continent".

Societies and Academies

Paris

Academy of Sciences, August 27 (*C.R.*, **199**, 501–544). Louis Blaringhem: The temperature of flowers. From the results of about 3,000 observations, the author concludes that most plants, at certain stages of growth and especially in the course of the development of the flowers, show a regular excess of temperature of the internal tissues and of the floral organs over the temperature of the surrounding air. This excess is usually 1°–6° but in one case amounted to 9°. Emile Mathias: Blue globular lightning. Hans Schwerdtfeger: The characteristic roots of the matrices of linear forms. Y. Why Fschen: Remark concerning the solution of the mixed problem relating to the equation $\Delta u - 1/\omega^2 u_{tt} = 0$ for $\omega \to \infty$. Rolf Nevanlinna: The harmonic measurement of ensembles of points. Edgar Odell Lovett: Bertrand's problem for certain curves which generalise conics. Charles Platrier: The most general infinitely small isothermal transformation of the homogeneous material medium. Miroslav Nénadovitch: Contribution to the theory of supporting wings. Pierre Lejay: Gravity anomalies in the south of Indo-China. A map is given showing the anomalies. Albert Pérard and Miroslav Romanowski: New comparisons of national standards of electrical resistance. Comparison of the standard ohms of Germany, United States, France, Great Britain, Japan and Russia, showing secular changes between December 1932 and November 1933. Paul Janet: Remarks on the preceding note. It is pointed out that this is the first work done by the Bureau international des Poids et Mesures in the field of electrical units. Arcadius Piekara: The magnetic anisotropy of the fatty acids. Pierre Bricout and Robert Salomon: The use of the cathode ray oscillograph for the study of the magnetisation of ferromagnetic substances. The apparatus described showed differences between specimens of identical composition when the annealing temperatures differed by only 10° C. It has proved capable of showing when the time of annealing has been sufficient to bring about the steady magnetic state. Charles Courtot and Abbas Motamedi: Introduction to the study of the chemistry of diphenylene selenide. Paul Seltzer: The vertical distribution of temperature in a forest. Jacques Emile Abelous and René Argaud: The formation of adrenaline in the suprarenal capsule. The rôle of lipids and lipoids in adrenalogenesis. Marc André: An American crayfish multiplying near Paris. Maurice Doladilhe: Researches on the complementary power of blood sera. Mlle. Mathilde Zirnhelt: A new culture medium specially favourable to the development and maintenance of the virulence of *B. typhi murium.* Sterilised rye, impregnated with ordinary peptone broth, forms an excellent medium for the culture of this organism. The virulence is increased and the rye can be directly used for the destruction of rats.

Cape Town

Royal Society of South Africa, May 16. J. L. B. Smith: The South African species of the triglid genera: *Lepidotrigla* and *Peristedion.* The paper revises the South African species of *Lepidotrigla. L. Faurei* and *L. Natalensis* are maintained as distinct species, and one new species is described. A new species of *Peristedion* is also described.

Geneva

Society of Physics and Natural History, June 7. Léon W. Collet and Ed. Parejas: The presence of the Upper Cretaceous in an alpine nappe of Elba. The authors describe grey limestones occurring at the Colle Reciso containing *Coccolithus pelagicus* and *C. leptoporus* with several species of *Actiniscus Ehrenberger*. It is the first time that Upper Cretaceous has been discovered above Biancone in Elba. Léon W. Collet: On a nummulitic breccia, with Wildflysch facies, from Elba. The elements of the breccia are made up of ophites. The cement is calcareous and contains *Nummulites lucasanus* of the Lower Lutetian. The formation of these breccias shows that movements occurred in the Lower Lutetian, in one of the alpine nappes of the island. Léon W. Collet and J. Buffle: The transportation of alluvial matter in suspension in the waters of the River Arve at Geneva, in 1933. The run off of the River Arve in 1933 was low. The total amount of alluvial matter transported in suspension in its waters was 1,506,000 tons. During 1915 the run off of the river was much larger and the alluvial matter transported amounted to 3,644,000 tons. Ed. Parejas: Some species of *Actiniscus* of the Upper Cretaceous of Brasses (Préalps médianes) and of the island of Elba. The author describes a fauna of *Actiniscus* observed in the red layers (Upper Cretaceous) of Brasses (Haute Savoie) and in a limestone of the Colle Reciso (Elba). The species *Actiniscus quinarius* and *A. Stella* have been found. The following species and varieties are new: *A. cruciatus, quinarius* var., *Stella Ehrenb.* var., *Colleti* var., *Chaixi, ilvensis, decapetalus* and *Verandi*. G. Tiercy: (1) The function introduced in the calculation of the distribution of the temperatures in the interior of a star. The numerical variation of this function has been given in a preceding note; it is now given as an algebraical function of the radius. An empirical solution, numerically satisfactory, has been found. (2) Remarks on a particular model of the

temperature distribution in a star. The author discusses a consequence which can be drawn from a formula given by J. H. Jeans for expressing the radiative viscosity of stellar matter. G. TIERCY and A. GROSREY: The width of the spectrograms of $F5$ and $G0$ stars. A discussion, as for other types previously studied, of the variation of the width of a spectrum as a function of the magnitude of the star and the time of exposure.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 6). I. M. VINOGRADOV: A new solution of Waring's problem. N. KOSHLIAKOV: Some identities in the analytical theory of numbers. L. LEIBENSON: Theory of the movement of petroleum in the stratum. V. T. MITKEVITCH: Some fundamental statements relating to the domain of physics. A. KRASIN: Influence of illumination on dielectric losses in rock salt irradiated with X-rays. The illumination increases the angle of losses by more than 12 per cent. N. DANKOV and A. KOTCHETKOV: On limiting dimensions for particles of catalysts. The maximum catalytic activity occurs with particles of 40 and 50 A., and absence of catalytic effect is to be expected close to 20 A. F. FEDOROV, I. MOTCHAN, S. ROGINSKIJ and A. SCHECHTER: Synthesis of ammonia by collision between positive ions. The action of positive ions consists in producing a new active form of nitrogen, not yet studied in detail. N. PETINOV: Grain quality control of irrigated wheats of the Transvolga areas. The quality of grain of irrigated wheats is not inferior to that of non-irrigated wheats. An increase in the protein content of the grain with a simultaneous increase in the yield can be obtained by regulating the watering. I. E. FIMOV: The distribution of organic remains in the roofing of coal measures of the Donetz basin. The following five successive facies are established by studying the fauna and flora of the respective strata; the continental or coal facies; the facies overlying the coal (with vegetable remains); the facies of anthracosids; the marine argillaceous facies; and the facies impregnated with hydrogen sulphide. L. LUNGERSHAUSEN: Stratigraphy of the "Balta" stratum. B. ZENKOVITCH: Some data on whales of the Far East. The food of the Californian grey whale (*Rhachianectes glaucus*, Cope) consists of the sea-bottom crustaceans living in the shallow parts of the continental shelf, mainly *Amphipoda*. There were no females amongst 57 sperm whales (*Physeter macrocephalus*, L.) caught in the Russian Far Eastern waters in 1933. Weights of *Balaenoptera physalus* and *Megaptera nodosa* are given.

MELBOURNE

Royal Society of Victoria, June 14. A. B. EDWARDS: Tertiary dykes and volcanic necks of South Gippsland, Victoria. A suite of dykes with a prevalent north-westerly strike, was intruded into the Jurassic sediments of South Gippsland in Lower Oligocene time. The suite comprises trachyandesites, analcite-olivine-dolerites, olivine-analcite-basalts, monchiquite-basalts, monchiquites, and possibly olivine-nephelinites. When arranged in this order of increasing basicity they exhibit chemical and petrological gradation into the adjacent types, and are considered to have been derived from a common magma, of a composition about that of the olivine-analcite-basalt.

ROME

Royal National Academy of the Lincei, May 6. P. ALOISI: Questions of Tuscan, especially Elban, geology (2). MARIA CIBRARIO: Certain theorems of the existence and unicity for the equation $xu_{xx} + u_{yy} + 2u_x = 0$. B. FINZI: Integration of the indefinite equations of the mechanics of continuous systems (2). G. PERETTI: Groups of electromagnetic waves in anisotropic media. According to the most general hypothesis of a medium which is magnetically isotropic and electrically anisotropic (for example, a crystalline medium), there exist, besides groups of electromagnetic waves of the first order, also groups of the second and third orders. J. J. PLACINTEANU: The wave equation of a body of variable mass. Application to radioactivity. G. L. ANDRISSI: Determination of latitude in prime vertical. A. CAVINATO: The use of the prism for the determination of the principal refractive indexes of crystals (1). Various methods, and the calculation of the errors involved, are discussed. V. CARMINATI: Cariometric determinations on the liver of rats inoculated with the nucleoproteins of calf thymus (2). Parenteral administration of the nucleoproteins of calf thymus produces a distinct increase in the nuclear dimensions of rat liver. C. GUARESCHI: First experimental results on the centrifugation of the chrysalis of *Lina populi* and of *Pieris brassicae*. GIUSEPPINA DRAGONE TESTI: Germination of embryos of grain outside the seeds. A. DE-AGAZIO: Action of histamine, ephetonine, caffeine and camphor on the isolated heart of *Bufo vulgaris* (3).

SYDNEY

Royal Society of New South Wales, August 1. G. J. BURROWS and R. H. PARKER: Some tetra-covalent platinum compounds derived from tertiary arsines. The authors describe the preparation of compounds of platinous chloride and platinous bromide with phenyl dimethyl arsine and with diphenyl methyl arsine. The derivatives are stable, crystalline, non-polar compounds with definite melting points of the type R_2PtCl_2, where R represents a molecule of the arsine. It was not found possible to separate any of the compounds into isomeric forms by means of solvents. Evidence of *cis-trans* isomerism was afforded by the behaviour on heating to the melting point. As a result of this treatment, the compounds appeared to change into forms having the same composition but solubilities different from those of the original compounds. F. P. DWYER and D. P. MELLOR: An X-ray study of opals. Powder photographs of opals which have been formed under different geological conditions fall into either one of the two classes: (*a*) those showing a well-defined diffraction pattern characteristic of β-cristobalite, (*b*) those showing a broad band in the position of the most intense line of either α- or β-cristobalite. Opals of the former class have been associated with lava flows at some time during their geological history, while those of the latter class have been associated with ground water only. It is considered that silica gel possesses a pseudo-crystalline structure—most probably α-cristobalite—and that under the influence of hot magmatic waters, inversion to β-cristobalite, followed by crystal growth, has occurred. The remarkable persistence of the β-form of cristobalite seems to be dependent on its low temperature of formation.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, Oct. 15

UNIVERSITY OF LEEDS, at 5.15.—Prof. C. Burt: "The Backward Child."*

Tuesday, Oct. 16

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. L. J. Henderson: "Physiological Equilibrium" (succeeding lectures on October 17 and 18).*

EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, London, W.1).—Prof. F. C. S. Schiller: "Ant-Men or Super-Men."*

KING'S COLLEGE, LONDON, at 5.30.—H. R. Lupton: "Pumping Machinery as Developed to meet Modern Conditions" (succeeding lectures on October 23 and 30).*

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.30.—Dr. W. Estorff: "Extra High Tension Engineering Practice (200 KV and upwards) with Special Reference to Power Transmission and Control" (succeeding lectures on October 17, 19, 22, 24 and 26).*

Thursday, Oct. 18

CHEMICAL SOCIETY, at 8—(at the Royal Institution, London, W.1).—Prof. P. M. S. Blackett: "Induced Radioactivity."

Friday, October 19

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 6—(in the lecture theatre, Literary and Philosophical Society, Newcastle-upon-Tyne).—Annual General Meeting. John T. Batey: Presidential Address.

SCOTTISH NATIONAL CONFERENCE ON THE PLACE OF BIOLOGY IN EDUCATION, Oct. 19.—Organised by the British Social Hygiene Council. To be held at City Chambers, Edinburgh.

Official Publications Received

GREAT BRITAIN AND IRELAND

Technical Publications of the International Tin Research and Development Council. Series A, No. 1: The Electrodeposition of Tin from Sodium Stannate Solutions with the Use of Insoluble Anodes. By A. W. Hothersall, S. G. Clarke and D. J. Macnaughtan. Pp. ii+101–124. Series A, No. 3: A Microscopic Examination of Iron-Tin Reaction Products. By Dr. W. D. Jones and W. E. Hoare. Pp. 4+2 plates. Series A, No. 4: The Corrosion of Tin and its Alloys. Part 1: The Tin-Rich, Tin-Antimony-Copper Alloys. By Dr. T. P. Hoar. Pp. 201–214+2 plates. Series A, No. 5: The Electro-Chemical Behaviour of the Tin-Iron Couple in Dilute Acid Media. By Dr. T. P. Hoar. Pp. 472–482. Series A, No. 8: The Improvement of White Bearing Metals for Severe Service; Some General Considerations. By D. J. Macnaughtan. Pp. 285–299+1 plate. Series A, No. 9: The Behaviour of White Bearing Metals when subjected to various Deformation Tests. Part 1: Indentation Tests, by A. S. Kenneford and Dr. Hugh O'Neill; Part 2: Tensile Tests, by R. Arrowsmith; Part 3: Pounding Tests, by H. Greenwood. Pp. 301–339+6 plates. Series A, No. 10: Some Properties of Tin containing small amounts of Silver, Iron, Nickel or Copper. By Prof. D. Hanson, E. J. Sandford and H. Stevens. Pp. 341–357. Series C, No. 1: The Féry-Carbone Dry Tin Accumulator. By Prof. C. J. V. Féry. Pp. 5. (London: International Tin Research and Development Council.)

Sir John Cass Technical Institute. Syllabus of Classes, Session 1934–35. Pp. 116. (London.)

Experimental Researches and Reports published by the Department of Glass Technology, The University, Sheffield. Vol. 16, 1933. Pp. iii+180+3 plates. (Sheffield.) 7*s*. 6*d*.

Board of Education: Science Museum. Technical Pamphlet No. 2: The Automatic Telephone; a Brief Description of the Processes involved in making a Call on the Automatic Systems of the British Post Office. By W. T. O'Dea. Pp. 13+5 plates. (London: H.M. Stationery Office.) 6*d*.

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1934–1935. Pp. 93. (Edinburgh.)

Proceedings of the Royal Society of Edinburgh. Vol. 54, Part 2, No. 15: The Structure and Relationships of Lamellibranchs possessing a Cruciform Muscle. By Alastair Graham. Pp. 158–187. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s*. 6*d*.

OTHER COUNTRIES

Agricultural Experiment Station of the Rhode Island State College. Bulletin 244: A Hemophilic Bacillus as the Cause of an Infectious Rhinitis. By J. P. Delaplane, L. E. Erwin and H. O. Stuart. Pp. 12. (Kingston, R.I.)

Exhibition of First Editions of Epochal Achievements in the History of Science (on Display at the University Library). Pp. 48. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 30 cents; 1*s*. 6*d*.

The Journal of the Indian Mathematical Society. Vol. 20: Silver Jubilee Commemoration Volume. Pp. x+248+2 plates. (Trichinopoly: Indian Mathematical Society.)

Punjab Irrigation Research Institute. Research Publication, Vol. 6, No. 1: A Gravitational Survey of the Sub-Alluvium of the Jhelum-Chenab-Ravi Doabs, and its Application to Problems of Waterlogging. By B. H. Wilsdon and Dr. N. K. Bose. Pp. 44+17 plates. (Calcutta: Punjab Irrigation Research Institute.) 5 rupees; 7*s*. 6*d*.

Summary Proceedings of the Twenty-eighth Meeting of the Indian Central Cotton Committee, Bombay, held on the 29th and 30th January 1934. Pp. 84. (Bombay.)

The Indian Forest Records. Vol. 20, Part 8: Immature Stages of Indian Coleoptera, 15 (Scolytidae). By J. C. M. Gardner. Pp. 17+2 plates. (Delhi: Manager of Publications.) 8 annas; 10*d*.

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 17: Fodders and Feeding Stuffs in Malaya. By C. D. V. Georgi. Pp. iii+35. (Kuala Lumpur.) 50 cents.

Forest Bulletin No. 84: The Identification of the Commercial Timbers of the Punjab. By K. Ahmad Chowdhury. Pp. vii+70+28 plates. (Delhi: Manager of Publications.) 3 rupees; 5*s*. 3*d*.

Publications of the South African Institute for Medical Research. Vol. 6, No. 33: Entomological Studies; Studies on Insects of Medical Importance in South Africa. By Dr. Botha De Meillon. Pp. 249–308. (Johannesburg.)

Union of South Africa: Department of Mines: Geological Survey. The Geology of the Country between Springs and Bethal; an Explanation of Sheet No. 51 (Bethal). By F. A. Ventner, with a Chapter on Underground Water Supplies, by H. F. Frommurze. Pp. 87. (Pretoria: Government Printer.) 5*s*. (including Map).

Hamburger Sternwarte in Bergedorf. Zweites Bergedorf Sternverzeichnis 1930.0. Nachtrag enthaltend die mittleren Örter von 671 Sternen (Eros-Anhaltsternen 1. Ordnung für die Opposition 1930–31) nach photographischen Aufnahmen mit dem AG-Astrographen in den Jahren 1930 und 1931. Herausgegeben von Dr. Richard Schorr. Pp. ii+81–92. (Bergedorf.)

The Indian Forest Records. Vol. 20, Part 7: Methods of Testing the Susceptibility of Timbers to Termite Attack. By Cedric Dover and R. N. Mathur. Pp. iii+20. 5 annas; 6*d*. Vol. 20, Part 9: Entomological Investigations on the Spike Disease of Sandal, (24) Pentatomidae (Hemipt.). By N. C. Chatterjee. Pp. ii+31. 10 annas; 1*s*. 6*d*. (Delhi: Manager of Publications.)

Records of the Survey of India. Vol. 25: Surveys in Swat, Chitral and Gilgit and neighbouring Territories carried out by 'A' Survey Company from 1925 to 1931. By Lieut.-Col. C. G. Lewis. Pp. vi+47. (Dehra Dun: Survey of India.) 1.8 rupees; 2*s*. 6*d*.

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1933 to March 1934. Pp. ii+16+2 plates. (Accra: Government Printing Office; London: Crown Agents for the Colonies.) 2*s*.

Commonwealth of Australia: Bureau of Meteorology, Melbourne. Bulletin No. 18: Foreshadowing Monsoonal Rains in Northern Australia. By H. M. Treloar. Pp. 29. (Melbourne: Government Printer.)

A Further Account of the Anti-Tsetse Campaign in Tanganyika Territory by Officers of the Tsetse Research Department. Pp. 32. (Shinyanga: Department of Tsetse Research.)

Tanganyika Territory: Department of Agriculture. Annual Report, 1933. Pp. ii+118. (Dar es Salaam: Government Printer.) 2*s*. 6*d*.

Uganda Protectorate. Annual Report and Bulletin of the Geological Survey Department for the Year ended 31st December 1933. Pp. 93. (Entebbe: Geological Survey.) 4*s*.

Fiskeridirektoratets Skrifter, Serie Havundersøkelser (Report on Norwegian Fishery and Marine Investigations). Vol. 4, No. 9: Animal Plankton of the Norwegian Coast Waters and the Open Sea. 1: Production of *Calanus finmarchicus* (Gunner) and *Calanus hyperboreus* (Krøyer) in the Lofoten Area. By Jacob D. Sømme. Pp. 163. (Bergen: A.-S. John Griegs Boktrykkeri.)

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CONTENTS

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The Native Problem and Research in Africa

THE work which has been carried out by Dr. H. L. Gordon, of Nairobi, on the mental capacity of the natives of Kenya, has attracted widespread attention in medical and scientific circles both in Africa and in Great Britain. As a result of his observations, he maintains that the brain of the African attains its maximum development at about the age of eighteen years, and that after that period there is a gradual decrease. Further, he finds that the average mental age of a group of educated Africans is equal to that of the European child at 10·5 years, and that senility might be expected at any age after thirty-five years; while in 2,000 post-mortems conducted by his colleague, Dr. Vint, not one subject had attained the age of sixty years.

Even more disastrous and far-reaching in effect is Dr. Gordon's investigation in so far as it bears on the mental stamina of the African. He finds that mental disease and weakness is peculiarly prevalent among those who have received an education on European lines. From these facts it has been inferred that European education is not suited to the intellectual capacity of the African, but sets up a series of strains and stresses affecting mental stability which all but the most robust are unable to withstand. Could this contention be shown to hold good generally, it would be an unanswerable argument in support of the views of those who maintain, on quite other grounds, that the present system of education in British Africa is unsuited to native needs.

The problem of the causes which underlie the mental and physical backwardness of the natives of Africa has recently been the subject of correspondence in the *Times*, and the case for immediate investigation was put by Sir Ernest Graham-Little with considerable force in a letter which appeared on August 28. He based his arguments to a great extent on Dr. Gordon's work in Kenya; but he also referred to the material relating to the pathology of the African and "the astonishing multiplicity of diseases in the individual native" given by Dr. J. H. Sequeira in a Chadwick lecture in 1932.

The gravity of the facts bearing on the health and general physical constitution of the native, especially in Kenya, is beyond dispute. Sir E. Graham-Little quotes the figures for child mortality in Kenya as ranging from 125 to 400 per thousand. In one large district, 94–98 per cent

of the children of less than ten years of age show traces of chronic malarial infection, and in a reformatory 75 per cent of the boys were infested with hook-worm, while yaws is almost universal. Pneumonia of pneumococcal origin is especially fatal and widespread. The degree of physical disability among the Kenya natives is illustrated by two recent instances. Among 16,754 men called up for enlistment as carriers, 10,912 were rejected on medical grounds and a further 17 per cent fell out on the march to Nairobi; and in a railway job employing 14,400 men, the death rate was 35·4 per thousand and admissions to hospital were 5,331. While lack of sanitation and ignorance are largely responsible for these conditions, the fundamental cause is generally held to be malnutrition.

While the great value of Dr. Gordon's pioneer work in Kenya is fully recognised, there are those who do not hesitate to question whether these data can be regarded as generally characteristic or his conclusions as widely applicable. When attention was first directed to Dr. Gordon's investigations, we pointed out (Nature, Dec. 23, 1933, p. 958) that, pending further investigation, certain reservations must be made. The uncertainty attendant on the application of intelligence tests to a native population are notorious, and difficulties of technique which stand in the way of adequate comparison on a racial basis still await satisfactory solution. Sir Grafton Elliot-Smith, in giving his strongest support to the proposed investigation, stressed the lack of comparative data and the difficulties which this lack imposes on investigators such as Dr. Gordon. He was also careful to enter a caveat against undue optimism in regard to the result of this specific inquiry. "No one," he said, "would be foolish enough to suppose that the examination of the brain alone is likely to explain the mental qualities of the native, but it is an essential part of the preliminary reconnaissance for the investigation of a problem of extraordinary difficulty and complexity."

Not only is the problem one of "extraordinary difficulty and complexity", but also it is one in which, it is almost superfluous to state, great issues are involved—issues which inevitably will affect the whole future of a great part of Africa. Upon the investigation of the conditions governing this problem no expenditure of money and energy, as Sir Grafton says, could be regarded as too great.

In one sense the greater part of Africa may be regarded as a vast anthropological laboratory of research. It is sometimes imputed to the science of man as a fault, when it is regarded as a scientific discipline, that, except within certain restricted and well-defined limits, it affords no opportunity for that experimental study which is complementary to observation in the strict canon of scientific method. The issues involved are too grave to admit of experimental interference with human lives for purely theoretical ends. Even observation is restricted by the fact that the life-cycle of man at every stage is too protracted to be readily brought within the focus of many branches of inquiry. Thus in the study of heredity, for example, lower organisms which multiply rapidly and are amenable to controlled conditions must serve as the raw material for generalisation and for the formulation of laws, of which the general applicability, and in this context, of applicability to man, must be accepted as a working hypothesis, subject to the test of further research.

Anthropology, however, is in a more favoured position than other sciences which depend mainly or entirely on observation. For anthropology the whole history of civilisation is a record of experiment—experiment in racial crossing and inbreeding, in cultural conservatism and innovation, in cultural cross fertilisation, in the effect of geographical controls and in the thousand and one other factors and influences which it is the business of the anthropologist, working in the field of archæology and ethnology, to unravel and interpret. It is in proportion as he knows and understands these experiments of the past that he is in a position to formulate laws for future guidance in practical affairs.

In this experimental laboratory, Africa will always hold a prominent place, notwithstanding the inferential character of much of our knowledge of the history of the peoples of the continent. It is a vast field in which over a long period many experiments have been made in racial movement, and in racial crossing, and also in culture contact. In this respect, it is true, Africa differs from Europe and Asia only in degree and not in kind; but its simpler societies and its racially less composite peoples more readily lend themselves to comprehensive observation and analysis than those in regions in which man's life and contacts have proceeded normally on a plane of more intense complexity.

In the greater part of British Africa, for example, the Bantu-speaking peoples, who form

the majority of the population, can be grouped as the product of two predominant racial strains, and their polity analysed as a result of the imposition of the culture of a cattle-keeping people on that of sedentary agriculturists, this fusion producing a peasant-farmer economy, which demands extensive grazing lands, in addition to garden plots, for the full development of its characteristic mode of life. How this piece of history bears upon current problems will be readily appreciated when it is recalled that it has been pointed out in connexion with the native situation in both Kenya and South Africa how the land problem is complicated by the fact that the natives habitually overstock and overgraze their land with disastrous results, but that no method of influencing them in the direction of moderation has as yet been devised. Indeed, one of the most influential of the leaders among the natives of South Africa, while recognising the evil, has declared that on no account must the cattle be touched by the European authorities. The cattle, in fact, are not only their form of wealth but also among their most sacred traditions.

Although much work of exploration and research has been done in Africa, it cannot be said that the factors which may be regarded as 'controls' are fully known, much less understood. Dr. Gordon's pioneer work is only one of many unexplored fields. Little is known, for example, of the racial constituents of the African peoples, for the usual conventional classification which divides the peoples we are here considering, the peoples of British Africa, into Negro and Bantu, with the remains and descendants of Bushmen and Hottentot in South Africa, rests, so far as the Bantu are concerned, mainly on a linguistic classification which covers a wide variation in physical character, generally regarded as due to Negro admixture with other strains not too clearly identified. In the investigation of the conclusions put forward by Dr. Gordon, racial questions will obviously become of no little practical importance. But the more the ethnology of Africa, the record of past experiment, becomes known, the more clearly does it become apparent to how great an extent does it enter into the practical problems of to-day.

Some indication of the far-reaching importance of investigations such as these are furnished by a recent publication*, edited by Dr. I. Schapera, on present conditions among the natives of South Africa. It consists of a series of chapters, in which (with the single exception of a chapter contributed by the editor dealing with the traditional culture of a typical South African tribe), a number of experts deal with various aspects of present-day life among the native population. Although each contributor has been left free to express his opinion on present conditions and to suggest, if he will, lines of amendment of present policy, the general tone is one of impartiality. The book may in fact be regarded as a scientific study of the natives of South Africa very much on the lines of a treatise in functional anthropology. Its value for the understanding of the native problem in South Africa is very considerable; but its mention here is justified rather on the ground of its bearing on the problem of British Africa as a whole, in so far as it is possible to reduce to a single formula the multifarious problems, which are individual in every people, if not almost in every tribe.

Broadly speaking, it is not unfair to say that native policy in South Africa has been a failure. This applies equally to the phase which regarded the proper relation with the native as a process of converting him into a dark-skinned European, and to the later policy which aimed at the segregation of the native from the white population, and since 1926 in all the provinces, following the example of Natal, has administered the affairs of the native in accordance with native ideas and institutions very much on the lines of 'indirect rule'. The lessons of the failure of the segregation policy are not without their moral for 'indirect rule' elsewhere. As time goes on, it becomes increasingly apparent that it can be no more than a stage in a direction which has still to be determined. This is, on the whole, the lesson of segregation. In South Africa, not only has complete segregation been impossible, owing to the number of urbanised natives; but also it has, so far, failed to afford the native the opportunities for development which were hoped from it. This is due to idiosyncrasies of Bantu culture which resist change, rather than to intellectual inferiority or incapacity, and would appear to suggest that the true end to which such policies as segregation or 'indirect rule' may lead in order to allow full play to the undoubted abilities of the native has still to be found. In this quest the investigation now suggested by Sir. E. Graham-Little may well be the first step.

* Western Civilization and the Natives of South Africa: Studies in Culture Contact. Edited by I. Schapera. Contributors: I. Schapera, W. M. Eiselen, W. G. A. Mears, G. P. Lestrade, Percival R. Kirby, H. M. Robertson, J. D. Rheinallt Jones, W. H. Hutt, Edgar H. Brookes, R. F. Alfred Hoernlé, D. D. T. Jabavu. Pp. xiv+312+12 plates. London: George Routledge and Sons, Ltd., 1934.) 15s. net.

The Native and his Industries in Northern Rhodesia*

By PROF. ALAN G. OGILVIE, O.B.E.

EVER since geography was re-established as an organised discipline, the essence of which is the study of terrestrial distributions and their inter-relations, geographers have been sifting and collating data of extremely varied character. The facts which have thus been incorporated in the body of geographical literature have themselves usually been established by workers in other fields, while geographers have drawn deductions from them, in many cases without having the opportunity to test their validity on the ground. As a result, generalisation and causation in regard to very large sections of the continents must necessarily rest on a rather insecure foundation. The question therefore arises—how can this be remedied ?

The basis of our knowledge of large parts of the southern continents and of Asia depends largely upon the accounts of primary exploration, some of the best of it contributed by the great pioneers, the naturalist travellers of the nineteenth century. Since their day the mesh of the net has become closer ; but the records of exploration having the character of traverses must nearly always be limited, since observations are usually confined to one season of the year.

The suggestion which I have to offer applies rather to regions where pioneer exploration is regarded as finished, and especially to the colonies and dependencies of the more advanced nations. I submit that these regions offer the most fruitful field for geographical research in the nearer future. As the chief reason for this belief I would mention the justifiable hope of the rapid extension of systematic surveys in such countries ; and we are agreed, I think, that the basis of all sound geographical research is a reliable topographic map, supplemented if possible by the results of geological surveys.

Let us consider Africa as an example, with special attention to its inhabitants. Anthropological literature has dealt very fully with the African races and is prepared to answer most of the questions that are usually asked relating to the natives. Nevertheless, the geographical controls or influences affecting the material life of these peoples usually receive far too little attention. Indeed, the physical environment as a rule is quite inadequately treated in the anthropological literature of the continent. A Research Committee of the British Association was therefore appointed after the Oxford meeting in 1926 to investigate the state of knowledge of the human geography of inter-tropical Africa ; and this Committee has been increasing its activities ever since. It set itself to state clearly the points upon which information was badly needed, and then proceeded to lay plans for tapping a body of knowledge which it believed to exist in Africa, but which hitherto had scarcely been tapped in the interests of geography. Scattered throughout this continent are many men and women, chiefly the district officers of Colonial Governments and missionaries, who, with long residence in close contact with the Africans and personal experience of the environmental conditions year in year out, should be able, by answering specific questions, to provide the essential link between the land and the mode of life of the natives. To them the Committee sent nineteen questions, most of which might be considered to apply to any of the regions envisaged.

HUMAN GEOGRAPHY OF NORTHERN RHODESIA

The most comprehensive response received so far has come from Northern Rhodesia, with the result that the Committee has at its disposal a series of thirty reports by the District Officers of the Protectorate covering nearly the whole territory.

The inquiry has elicited certain facts about the modification of the natural vegetation by the natives. The great majority of the people live upon their crops, and most of these are raised in partial clearings of the savanna. The natives are truly men of the trees, apart from which they cannot live. The essential feature of their system of shifting agriculture is the annual felling or pollarding of trees, and the application to the soil of the ash derived from burning the wood on the site of their gardens. The area of woodland cut for a garden of given size of course depends first upon the luxuriance of the trees, and secondly upon the nature of the practice—whether pollarding or felling. The estimates of the ratio of timber area cut to area of garden vary between 4 : 1 and 10 : 1. The estimates of the period required for recovery of the woods are more numerous, but they are difficult to interpret in view of the inadequate accounts of the vegetation. Several District reports mention rest periods as short as four or five years ; in others these are between ten and twenty, and in Barotse thirty to thirty-five years.

The degree in which the savanna has degenerated under this system of agriculture depends largely

* From the presidential address entitled "Co-operative Research in Geography, with an African Example" to Section E (Geography) of the British Association, delivered at Aberdeen on September 6. The full address is being printed in the November issue of the *Scottish Geographical Magazine*.

upon the density of the population. Many writers point out that tracts of the natural vegetation still exist simply because the population is small—as, for example, in Chinsali with three per square mile. But such figures are misleading, for the actual densities on land desirable from soil and water qualities are very much greater. Moreover, the native cuts wood for many purposes besides that of manuring his garden. Finally, there is the damage to seedlings and young trees caused by the annual grass fires which sweep the territory, started for various reasons.

EXTERNAL INFLUENCES

The effect of European influence upon the economic and social structure of native society in Northern Rhodesia has recently been very thoroughly dealt with by Mr. Merle Davis. Yet it is interesting to attempt an estimate, based upon our District reports, of the nature and degree of external influence upon the material life of the natives. The use of manioc (*Cf.* Fig. 3), and the square or oblong type of house which to-day prevails in the north-west, seems to result from indirect contacts with the Portuguese on the Atlantic seaboard. Since 1917, the new wave of immigrants from Angola has led to the spread of this house type throughout the upper Zambezi basin.

Much more important are the influences due to British rule and partial settlement by European farmers, the rapid exploitation of minerals in the Belgian Katanga and the Ndola and Broken Hill Districts of the Protectorate; while the establishment of missions throughout Rhodesia has had widespread material as well as moral effect. Indexes of the outward evidence of this permeation are: the distribution of houses built on the European pattern; the continuance or otherwise of the old-established native iron industry; and the direction and volume of movement of native labour to work for Europeans (Fig. 1).

It is evident from the reports that while European influence is greatest along the central railway belt, yet the attraction of the mines as a source of employment and a market for surplus food is widespread, though variable, throughout the Protectorate. A universal effect of the new security is the replacement of the old stockaded village of large size by smaller groups varying according to local geographical conditions.

POPULATION DENSITY

The average density of population for the whole Protectorate is a little more than four per square mile; but it is unevenly distributed. Thus, two Districts in Barotse Province, Kalabo and Mongu, have densities of 11·6 and 16·3 respectively; Chienji on Lake Mweru has 13, while Fort Jameson has 20·8. On the other hand, in a belt from the Katanga border southward to Sesheke the District densities vary from 1·3 to 2·5, while in the railway belt to the east of this, figures are between 3 and 4.

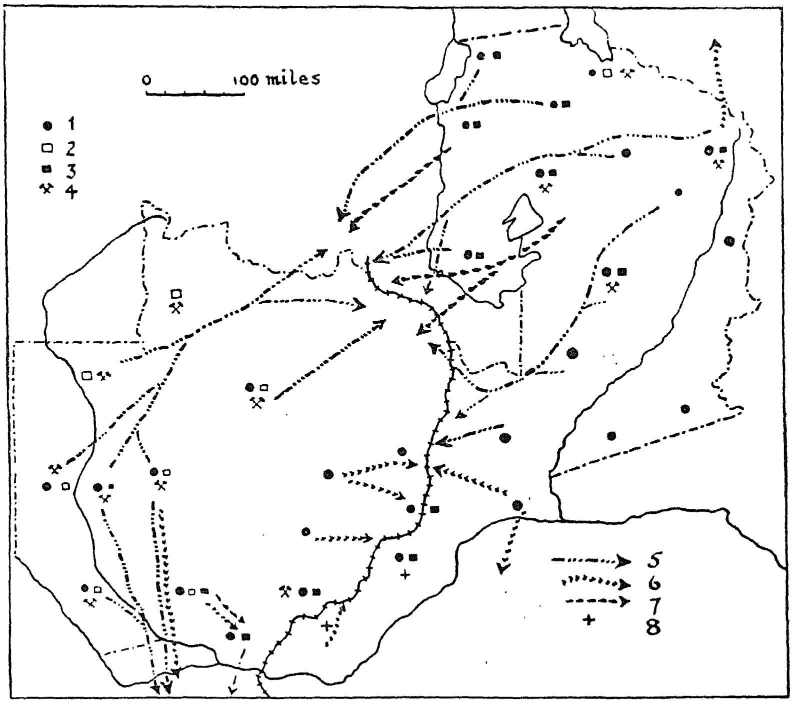

FIG. 1. Cartogram of Northern Rhodesia to illustrate effects of external influences. (1) Rhodesian circular house; (2) rectangular house of Bantu or Swahili origin; (3) rectangular house on European model; (4) native iron industry reported as still in operation; (5) annual migration to European mines and (6) to other European employment and (7) to market produce; (8) surplus produce sold locally.

But it is the examination of life conditions which brings realisation of the real arrangement of the natives. For example, in Mkushi they live along the river valleys with a probable density of 50–60 per square mile instead of 2·77 for the District.

The type of locality which carries the greatest population is that which provides a means of livelihood apart from agriculture; and fishing is by far the most usual supplement of this kind. Indeed, it becomes the dominant occupation around Lakes Bangweolo and Mweru, where the islands and shores have about 80 persons per square mile. Such areas of good fishing which are also excellent land for producing manioc have received access of population in recent years on account of the

encouragement to market fish and meal in the mining areas to the west. The great alluvial plains of the Barotse, the Kafue Flats, and the reserves east of the Luangwa are all relatively populous districts in which cattle are held by cultivators. Apart from the areas mentioned and a few others less notable, the population densities, calculated on the assumption of stream-bank arrangement, would seem to vary from, say, 5–10 per square mile in Districts of small population to 40–50 in the more populous.

TSETSE FLY

No element of the human environment is more important than the distribution of the tsetse flies (*Glossina*). *G. palpalis*, the carrier of sleeping sickness, appears happily to be either absent or innocuous over nearly all the country. But with the bearers of *Nagana* it is quite otherwise. Their distribution, as plotted from the reports and certain local maps, reveals three large tracts that are free of fly. The first includes the greater part of Barotseland. East of this lies a broad fly belt; within this the flies seem to be spreading, and at the southern end the belt is extending both eastward and westward toward the native and European cattle land of the lower Kafue and the railway zone. This latter, with its greater amount of cultivated land, is still free of fly to the edge of the great escarpment, and the same is generally true of its continuation north-eastward along the divide between the Chambezi and Luangwa; Broken Hill and Mkushi even report a reduction in fly. The Luangwa fly belt shuts off the clear area of the Nyasaland border, and at the head of the valley the pest is encroaching on the plateau land. The tsetse distribution is more patchy in the northern areas. Generally speaking, the higher lands are the freer. In Fort Rosebery the fly is local, and Kasama records a reduction; but evidently there are few areas which can safely be reached by cattle.

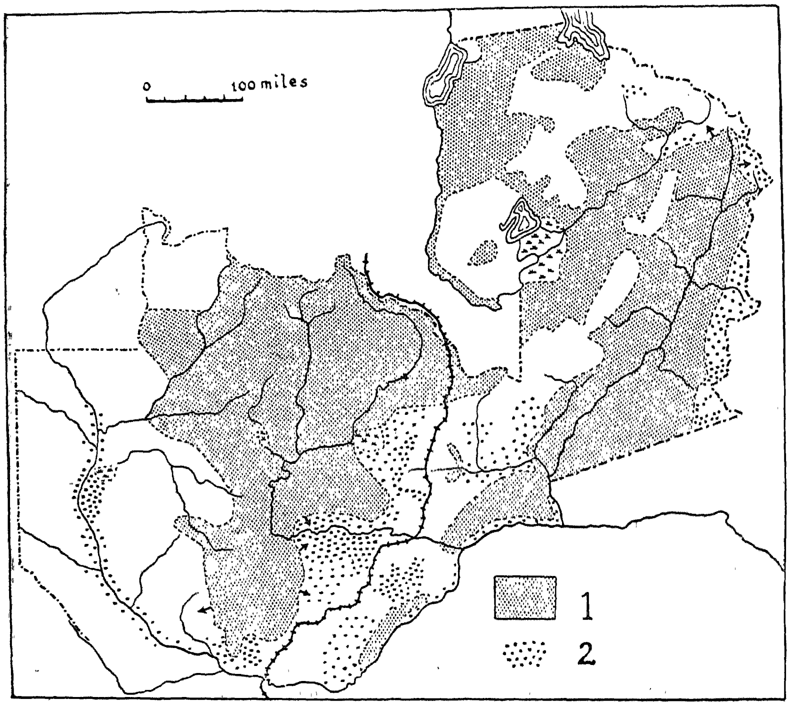

FIG. 2. Sketch-map of Northern Rhodesia, showing distribution of (1) tsetse fly and (2) native-owned cattle.

Fig. 2 indicates clearly the prevalence of tsetse in the hot lowlands, but the controlling factor on the plateaux, which is doubtless the character of the vegetation, cannot be examined until a survey of that element has been made. The nature of the wild fauna is a contributory factor; and while the reports contain useful information regarding the wild animals which are hunted or cause depredations to crops, it is insufficient to allow of any important deduction.

CATTLE

While cattle are restricted to the areas free of fly, they are by no means evenly distributed throughout those parts. Nor are they of equal significance in the life of their owners, chiefly on account of varying tribal tradition in regard to cattle, but also from the incidence of European influence. In Barotse the herds vary according to the available pasture, being greatest on the Zambezi plain (in Mongu *circa* 50,000 head) and decreasing north and south. Cattle in general are regarded merely as wealth, chiefly in relation to the marriage security, sometimes as a source of meat and of hides, more rarely of milk. But in contact with Europeans and a market, the tribesman tends to devote his animals to work, notably with the acquisition of the plough in the alluvial plains, of two-wheeled carts on suitable ground and of sledges elsewhere. It is chiefly in the vicinity of the railway that the natives are following European guidance in the matter of breeding and of dipping. Elsewhere the herds receive little attention, and consequently the stock is poor. Furthermore, the Barotse cattle were stricken with pleuro-pneumonia in 1915 and their numbers reduced by perhaps 50 per cent. In the central

Districts, on the other hand, stock is increasing, owing to the natives' contact with Europeans. Here there is some danger from overstocking, which reacts not merely directly on the animals, but also results in rapid erosion of the soil wherever there are slopes.

Transhumance is practised by the cattle owners of the Barotse Plain and the Kafue Flats, in each case in response to the flooding of the alluvial belt; and in each case this has great effect upon the social and economic life of the tribes concerned.

Food Staples

The distributions of four of the leading food crops of Africa meet and overlap in Northern Rhodesia; the three cereals, comprising the great millet (sorghum), the lesser millets, of which eleusine is the most important, and maize. These, with manioc (cassava), form the food staples of the native population. Allowing for some uncertainty as to the identity of the millets mentioned by the authors of reports, it has been possible to plot the crop distribution with general accuracy (Fig. 3). It is thus evident that the small millets, especially eleusine, prevail in the north-eastern plateau, while sorghum is more cultivated in the central Districts. This crop, however, has yielded the first place over most of its area to maize, most probably introduced from the south and certainly increasing where the contact with European farming is close. The most outstanding fact elicited is the penetration of the territory by manioc as a staple crop. The lower Congo region is generally held to have been the centre of dispersion of this American plant, and it will be interesting to learn whether its area is now unbroken to the Rhodesian border. It is clear that manioc is still being carried south-eastward by the Angolan immigrants in Barotse, and, for several reasons, its cultivation is being encouraged elsewhere by the administration. The dependence upon these crops is closely related to the distribution of soil and vegetation types, to the incidence of rainfall and to the annual flooding of the rivers.

In addition to the matters referred to, this piece of co-operative research in human geography has yielded much information upon animal pests and the amount and nature of hunting; upon fishing in relation to the rise and fall of rivers; upon the seasonal migrations in search of fish and various food relishes. Most important of all is the whole subject of seasonal rhythm of occupation and its regional variations, a matter upon which the reports are of great service.

It is much to be hoped that surveys of the other African territories will be undertaken. Moreover, I am looking beyond Africa to countries where many Europeans reside, people who may never have thought of geography as we regard it, but who might well be sufficiently interested in the land of their choice to be willing to take part in the kind of team work which I have outlined. Take India as an example. In spite of voluminous official and other literature, we have still a great deal to learn of the geography of man in the sub-continent. Although the task of gathering the information there would be much more complex than in the case of Africa, there would be certain offsetting advantages. Among these are: the accuracy of the map of India, the existence of a great body of data created by the various scientific services, and a wonderful census organisation. In addition, there is the likelihood that men of science could be found on the spot who would be able to fill in the gaps in the picture of the physical environment. These might be asked to deal with the numerous connecting links which are not usually required for official departmental reports, but are, nevertheless, essential to the geographer.

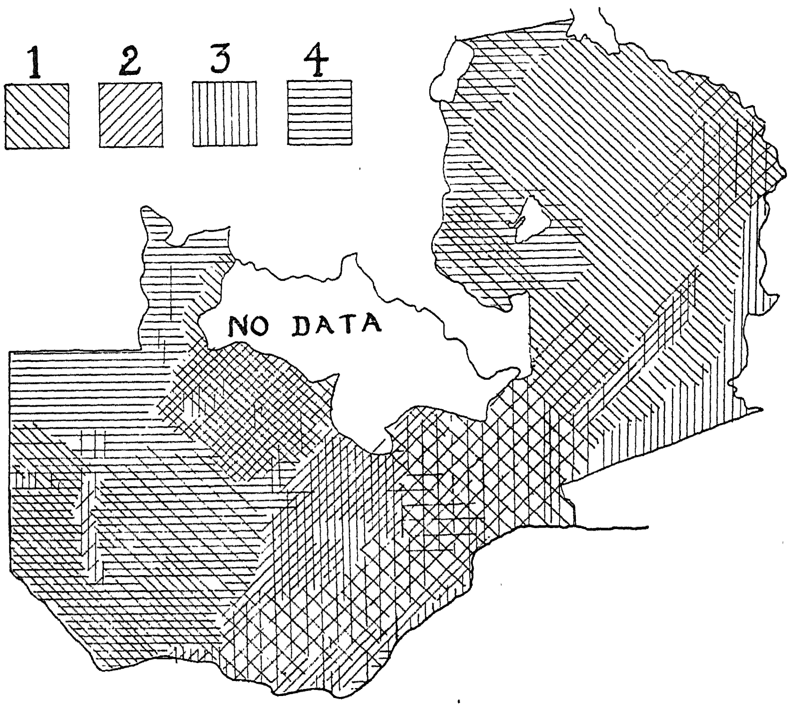

Fig. 3. Cartogram of Northern Rhodesia, showing distribution of leading food staples. (1) Small millet, generally eleusine; (2) sorghum; (3) maize; (4) manioc (cassava). For sake of visibility, lines have been drawn over European as well as native areas.

Societies and Centenaries

A STUDY of the history of those societies whose interests are in the main scientific and literary would form a task pleasant enough and, in all conscience, comprehensive enough for a student of the development of scientific thought. Even if we restricted ourselves to a study of our own national societies, the field would be sufficiently wide to tax the energies of a single worker. A start has been made. Weld (the works of Sprat, Birch and Thomson can scarcely be termed histories) has traced the origins and the varied fortunes of the Royal Society from the struggling days when its unlucky secretaries were threatened with "Books of Fishes" in lieu of sterling payments, to the more settled generations just preceding our own; we wait and hope for a worthy successor to Bence Jones's account of the Royal Institution; Dr. Howarth has told us the fascinating story of the growth of the British Association; and, under his editorial guidance, the Association has published a history of London's contributions to science which contains a valuable but necessarily brief account of the principal London scientific societies.

The great provincial societies have not lacked their historians, although there is here room for an account which shall synthesise these remarkable activities, shall give us a co-ordinated account of cognate societies of lesser repute, and show us what an important part has been played in the past and is still being played by societies such as the Manchester Literary and Philosophical Society and the sister societies in Leeds, York and Newcastle. To the Manchester society, for example, falls the signal honour of publication of the first estimate of an absolute molecular magnitude, for it was, I believe, to that Society that Joule communicated his calculation of the root mean square velocity of a molecule of hydrogen at standard temperature and pressure (the value he gave was 6,055 ft. per second; Childs' tables give 6,037 ft. per second).

In connexion with such societies, it is in the nature of things that our own generation should have witnessed a flood of jubilees and single, sesqui- and bi-centenaries; and it is to the credit of the societies concerned that they should hasten to give to the world some account of their origins and growth, the celebrations becoming something more than an occasion for a series of such gargantuan feastings as are permitted to a post-War world. But there are other societies, some still in existence, some vanished and gone, of which we know little beyond their names, *carent quia vate sacro*. Of some, indeed, we may find a record in rare volumes and obscure appendixes, but here again we could wish for a modern synthesis of their activities which should place in its proper perspective the not uninteresting story of their growth and decay.

What of that Society for Philosophical Experiments and Conversation the minutes of which for the year 1794 are printed for T. Cadell, Junior, and W. Davies (successors to Mr. Cadell) in the Strand—a society which was instituted in London on January 25, 1794, at the house of Dr. Higgins, and held weekly meetings during the session of Parliament under the chairmanship of Field Marshal Conway—the "Didactic Experimenter" being Dr. Bryan Higgins? What of that Birmingham group of which Priestley, Watt, Boulton, Darwin, Galton and Wedgwood were distinguished members—a group which met at dinner monthly "calling ourselves the Lunar Society, because the time of our meeting was near the full moon, in order to have the benefit of its light in returning home"? Like the famous *x* club of a century later, its existence depended on those members who called it into being, and Watt was probably the last surviving member. De Morgan gives us a fascinating glimpse of that artisan mathematical society which flourished in Spitalfields for well over a century, a society in which every man had "his pipe, his pot and his problem"; in which, by the constitution of the society, it was "the duty of every member if he be asked any mathematical or philosophical question by another member, to instruct him in the plainest and easiest manner he is able". The society's existence extended over some one hundred and thirty years, and when, about 1845, its membership had declined to nineteen, the society, with its library, was absorbed by the Royal Astronomical Society. Some of its books, duplicates of those possessed by the Royal Astronomical Society, are to be found in the library of the Physical Society. In its mature years, the society was live and lively. Tempers ran high at times, and we read that "if any member shall so far forget himself and the respect due to the Society as in the warmth of debate to threaten or offer personal violence to any other member, he shall be liable to immediate expulsion, or to pay such fine as the majority of members shall decide".

So much for societies dead and gone; the centenary of the Royal Statistical Society, the circumstances of the origin of which are of special interest in view of the happenings of to-day, has been marked by the production of a history of the Society*. At the Cambridge meeting of the

* Annals of the Royal Statistical Society, 1834–1934. Pp. xii+308+8 plates. (London: Royal Statistical Society, 1934.) n.p.

British Association in 1833, a group of enthusiasts formed, somewhat irregularly, a new statistical section. The presence of Quetelet had something to do with its formation, and the new section was recognised by those in authority, although it can scarcely be said to have received their blessing. The president, Adam Sedgwick, delivered himself of some good advice in the rotund style of the day, informing the culprits that because of the irregular circumstances of its formation he would not read the report of this "self-formed Section", and reminding his hearers that "the things with which the Association had to do were the laws and properties of matter and with those alone". Statistical inquiries might be admitted so long as they dealt with "matters of fact, with mere abstractions and with numerical results. . . . These inquiries, however . . . touched the mainsprings of passion and feeling . . . they blended themselves with the generalizations of political science; but when they entered on these higher generalizations that moment they were dissevered from the objects of the Association and must be abandoned by it if it meant not to desert the secure ground which it had now taken. . . . The daemon of Discord would find his way into their Eden of Philosophy."

As the historians of the Society remark, there was more to the same effect. It is small wonder that the Statistical Section resolved that "a more permanent body was necessary to carry out the views and wishes of the Section and it was agreed to establish a Statistical Society in London". Hence arose that public meeting of "Noblemen and Gentlemen" at 21 Regent Street, on March 15, 1834, which marked the beginning of the long and honourable career of what is now known as the Royal Statistical Society.

The annals of its development, as recounted in the scholarly pages of the centenary volume, are absorbing, if unexciting. The progress of the Society is traced with admirable clarity from these modest beginnings to a stage at which, amid a host of other activities, it is playing an important part in forwarding the application of statistical methods to various problems of industry, and the accounts of the work of those eminent statisticians who have cherished the interests of the Society in the past are associated with pleasant little sketches of their personalities which add a living interest to the picture. Perhaps the one trivial criticism, if criticism it may be termed, which can be brought against a wholly delightful volume, is that there are scarcely enough of these touches. We could wish that a president of the Statistical Society could be found who should say of a dull paper, as the venerable Dalton announced in an audible undertone from the rostrum of the Manchester Literary and Philosophical Society, "Well, this is a varra interesting paper for those that take any interest in it".

The Council of the Society, and the distinguished authors of the centenary volume, Dr. Bonar and Mr. Macrosty, are to be congratulated on the issue of a volume that must form a norm for all future writers faced with a similar task.

ALLAN FERGUSON.

Science and State Regulation of the Sea Fisheries

On September 22, 1863, a Royal Commission commenced inquiries into the Sea Fisheries of the United Kingdom of Great Britain and Ireland. Prof. T. H. Huxley and his fellow commissioners visited eighty-six places, examining methods of fishing in use and interrogating witnesses. Their Report, published in 1866, was a masterly summary of the situation, embodying courageous recommendations in accordance with a declared legislative principle. The first recommendation was as follows:

> "We advise that all Acts of Parliament which profess to regulate, or restrict, the modes of fishing pursued in the open sea be repealed; and that unrestricted freedom of fishing be permitted hereafter."

And the principle:

> ". . . that (apart from the restrictions prescribed by international law, or by special treaties) the produce of the Sea is the property of the people in common; and that methods of fishing are fitting subjects for legislation, only so far as such legislation can be shown to be necessary to secure the greatest possible advantage to the whole nation from the Sea Fisheries; either by suppressing wasteful and uselessly destructive modes of fishing; or by removing legislative obstacles in the way of improved modes of fishing; or by preserving peace and order among fishermen."

Broadly speaking, the great deep-sea fisheries of the present day have been developed under that "unrestricted freedom of fishing" advocated by the 1863 Commission, without let or hindrance in the form of national or international regulation. The passing into law of the Sea-Fishing Industry Act of 1933, therefore, by granting State control over fishing operations, marked the end of nearly seventy years of free fishing by British vessels in the high seas.

By this Act, the British Government has acquired powers to regulate and restrict the fishing of British vessels whereby fishing grounds, times of fishing, fishing gear, quantities of fish to be landed and their quality—all of these being matters over

which the fishermen formerly exercised freedom of action—are brought under State prescription. Landings of foreign-caught fish are also regulated. Furthermore, by the same Act, the Sea-Fish Commission for the United Kingdom came into being, to investigate and advise the Government as to whether any, and if so, what, steps ought to be taken for reorganising any branch of the nation's sea-fishing industry. One of the first services of this Commission has been to present a Report on the Herring Industry[1], recommending the establishment of a Herring Board having far-reaching powers.

Now it cannot be denied that the Sea-Fishing Industry Act was passed, primarily, to rehabilitate an industry most grievously hit by the general economic depression, but it would be a profound mistake to adjudge the Act solely as a measure to meet business exigencies. Indeed, there appears no escape from the conclusion that, unless the fundamental legislative principle laid down by the Royal Commission of 1863 has been put aside, the Act is nothing less than an indictment of the fishing industry for its "wasteful and uselessly destructive modes of fishing".

In this connexion, the findings of the International Council for the Exploration of the Sea during the meetings held at Copenhagen in June last, are of outstanding significance. Delegates and experts from Belgium, Denmark, Finland, France, Germany, Great Britain, Holland, Norway, Poland, Portugal and Sweden, arrived at fifteen conclusions which were accepted and adopted, with slight amendments, by the Council on June 9. Nine of these conclusions, as they appear in the (amended) Authentic Text[2], are given below :

(1) It is important, for the maintenance of the stock, that measures to prevent waste be taken by all countries fishing in the waters included in the Council's investigations.

(2) The most useful measure of control will take the form of prevention, as far as possible, of the capture of young fish below the size at which they can be sold at a remunerative price for the food of man.

(3) It has been shown that, in the case of the trawl net and Danish seine, appreciable protection of young round-fishes can be secured by regulating the size of mesh of the bag or cod-end. This method needs to be further elaborated, but enough experience has been gained to justify a minimum size of mesh which should be required in the construction of the bag or cod-end employed in the open sea.

(4) The minimum mesh which the Council recommends is that already enforced by the regulations of the British Government, which, they are satisfied, will ensure the release of an appreciable quantity of undersized fish now captured and retained.

(5) No way at present practicable of regulating the mesh has yet been devised which would secure the release of flat-fishes up to the sizes at which they ought to be protected and would not release marketable round fish.

(6) It is, therefore, desirable that size-limits should be imposed for flat-fishes in order to discourage fishing on grounds where small flat-fishes form the greater part of the population.

(7) The imposition of size-limits is also desirable for round-fishes, in order to re-inforce the mesh-regulations, and to remove the temptation for fishermen to evade those regulations when at sea.

. . . . .

(12) The Council recommends the adoption by all countries, as soon as possible, of size-limits not less than those required by British regulations. It is of the opinion that experience will show that some of these might be usefully extended, and that size-limits might also be introduced with advantage for other fishes, especially cod. It wishes, however, to emphasize the fact that the chief thing to aim at is the prevention of the *capture* of undersized fish, and that accordingly the regulation of fishing should take first place.

(13) The Council recognizes the difficulty of enforcing different measures of protection for different areas and different fisheries; but it considers that, when the question of increasing the minimum measures now proposed arises, this question will have to be faced and solved.

From these conclusions of competent scientific representatives of all the leading fishing nations of Europe, it would surely seem that the Sea-Fishing Industry Act was not only right in its indictment of wasteful fishing, but also in the methods by which it sought to check this waste. It is especially gratifying, therefore, that the trawling industry has so cheerfully co-operated with the Fishery Departments of the Government to secure the smooth working of the Orders already imposed under the Act, despite the fact that the fishermen of other nations, working the same fishing grounds, have remained free from such regulation. This very circumstance may well prove to be one of the strongest factors in inducing the Governments of Europe to follow the British lead towards the maintenance of fish-stocks at an adequate level, and to ensure that they are utilised in the most economic manner.

Finally, it should not be lost to view that the vitally important conclusions of the International Council were based on knowledge derived from thirty-two years of scientific investigation in which the nations have co-operated. With the fisheries brought under legislative control, the need for scientific surveillance will be greater than ever, not only to perfect the means of protection against wasteful fishing, but also to preserve the fisheries from that purely obstructive legislation which Huxley so fearlessly and rightly condemned.

E. F.

[1] Sea-Fish Commission for the United Kingdom. First Report: The Herring Industry. (Cmd. 4677.) Pp. 51. (London: H.M. Stationery Office, 1934.) 9*d*. net.

[2] Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 90: Size-Limits for Fish and Regulations of the Meshes of Fishing Nets. Pp. xv+61. (Copenhague: Andr. Fred. Høst et fils, 1934.) 3.00 kr.

Obituary

SIR ARTHUR SCHUSTER, F.R.S.

ON Sunday, October 14, Sir Arthur Schuster passed away at Yeldall, his home near Twyford, Berkshire, after a long and distressing illness. Thus is broken one of the few remaining links with the physics of the second half of the nineteenth century.

Sir Arthur Schuster was a member of a Frankfort-on-Main family which, so early as the middle of the eighteenth century, had established a business in cotton goods in England. His father, while retaining an interest in the English business, founded a successful banking firm in Frankfort-on-Main; but in 1869 he removed with his family to England, taking charge of the Manchester branch of the firm of Schuster Brothers. Arthur Schuster was born in Frankfort on September 12, 1851, and spent the first sixteen years of his life in that town. He received his early education in the Gymnasium and then was sent to Geneva where, during two happy years, he studied French and attended lectures at the "Academy". In 1870 he joined his parents in Manchester and entered his father's business. There can be little doubt that his experience during these early years had a great influence on his future life, for he gained a complete mastery of the English, French and German languages and, although against the grain, learnt something of business methods.

Schuster was not happy in the business; he found more pleasure in attending evening classes at the Owens College, and in less than a year he had induced his father to let him take up science as his life's work. He now entered Owens College as a day student, and for a year studied under Balfour Stewart; and then having become interested in spectrum analysis he went, on the advice of Roscoe, to Heidelberg to study under Kirchhoff. He spent two years in Heidelberg, obtaining his Ph.D. in 1873.

On his return to Manchester, Schuster found that Owens College had been removed from its cramped and primitive quarters in Quay Street to its present site, where three rooms in the basement had been set aside as a physical laboratory. Balfour Stewart was still the professor of physics and Schuster became his unpaid demonstrator. Little did Schuster foresee, as he worked in the three-room laboratory, that only twenty-seven years later he himself would be the professor of physics with a laboratory, built to his own design, consisting of forty rooms. But at this time Schuster had no intention of settling down at Manchester; that was to come seven years later. In the meantime, he studied at Göttingen under Wilhelm Weber and Riecke and at Berlin under Helmholtz; led (at twenty-four years of age) the British eclipse expedition to Siam; put in another year as honorary demonstrator at Manchester, when —as he was proud to recall—he gave a course of lectures on Maxwell's theory of electricity which was attended by J. J. Thomson; worked for nearly five years at the Cavendish Laboratory, Cambridge, first under Clerk Maxwell and later under Lord Rayleigh; and during the summer vacation of 1878 took part in his second eclipse expedition, this time to Colorado.

In 1881 a professorship of applied mathematics was founded at Owens College and Schuster was appointed to the chair. He held this professorship for seven years, during which his work was physics rather than mathematics, and he took part in two more eclipse expeditions, to Egypt in 1882 and to the West Indies in 1886.

In 1888 Balfour Stewart died and Schuster was appointed to succeed him as Langworthy professor of physics in the Owens College, a professorship which he retained until his retirement in 1907, when he was succeeded by Lord Rutherford. Thus Schuster's association with Owens College, Manchester, was a long one, commencing when he first attended Roscoe's lectures as a night student in 1870, and terminating in 1907 after he had been professor of physics for twenty-six years. It was a period of great development: in 1873, when Schuster first taught in the laboratory, there were only about ten students; when he retired in 1907 there were about 150 students taking elementary courses and 100 doing more advanced work.

Schuster commenced his active scientific life just at the time when physical laboratories were being established at the British universities and, as we have already seen, he worked in two of them in their very early days. The period of qualitative discovery of new physical phenomena appeared to be over: the main facts of electricity, magnetism, optics, spectrum analysis, etc. were known; and, as a matter of fact, no further discovery of a fundamental nature was made until the discovery of Röntgen rays at the end of 1895, by which time Schuster's period of active research was nearing its end. Schuster's scientific work was, therefore, concerned almost entirely with what may be called the 'old physics'; but he lived long enough to follow with the greatest interest and pleasure the progress of the 'modern physics' in which his old laboratory at Manchester has taken such a distinguished part.

It has already been mentioned that Schuster, while still a student, was attracted to spectrum analysis, and his first paper, published when he was twenty-one years of age, was on the spectrum of nitrogen. It was spectrum analysis which gave him his interest in eclipse work, and on his third eclipse expedition he succeeded in photographing the spectrum of the solar corona for the first time. Laboratory work on spectra, mainly the spectra of gases in Geissler tubes, naturally led him on to problems connected with the discharge of electricity through gases, on which subject he wrote many papers and delivered two Bakerian Lectures (1884 and 1890). He was the first to attribute the conductivity of gases at low pressure to the formation of gaseous ions, and he made the first determinations of e/m by means of the magnetic deflection of cathode rays, but did not obtain a good result.

Schuster became more and more interested in what we now call geophysics, and the relationship between geophysical and solar physical phenomena. One of his most important papers was an analysis of the daily variation of terrestrial magnetism, in the course of which he proved that the electrical currents responsible for the daily magnetic changes were external to the earth; and in a later paper he showed that qualitatively these currents could be explained by the induction currents which would be set up by the daily variation of the barometer if the upper atmosphere were highly conducting. This was a development of a suggestion made previously by Balfour Stewart and was itself the forerunner of Heaviside and Kennelly's explanation of the propagation of wireless waves around the earth. Schuster made other valuable contributions to the theory of terrestrial magnetism and was particularly interested in the relationship between magnetic storms and the processes taking place on the sun.

Schuster did not himself carry out investigations in seismology; but he was deeply interested in this branch of geophysics and was for some time chairman of the Seismological Committee of the International Association of Academies and served on other committees both international and British dealing with seismology. In 1910 he presented a set of Galitzin's horizontal seismographs to Eskdalemuir Observatory. In 1925 these instruments were transferred to Kew, and during the last few years in particular their records have been the subject of intense and very productive original work.

Meteorology was always a favourite subject with Schuster, and he gave much time and thought to the organisation and administration of the Meteorological Office. In 1900 he was appointed by the Royal Society to be an additional member of the Meteorological Council, the Meteorological Office then being under the control of the Royal Society. When the constitution of the Office was changed in 1905, Schuster became the Royal Society's representative on the new Meteorological Committee, a post which he held until November 1932, when his failing powers made it no longer possible for him to serve. Thus for more than thirty-two years Schuster sat on the governing body of the Meteorological Office, seldom missing a meeting, and taking intense interest in the development of the meteorological service. He also showed his interest in meteorology by persuading the University of Manchester to establish in 1905 a University lectureship in meteorology, the first post for the teaching of meteorology in a British university, and at his own cost he established in 1907 a readership in meteorology at Cambridge.

No one will question Schuster's eminence as a man of science; but it is doubtful whether he was not an even greater administrator. It was impossible for Schuster to be connected with any undertaking without being called upon to take part in its organisation and administration. During the whole of his association with Manchester, he was a leading spirit in all University affairs and he took a large part in the movement for the conversion of the old Victoria University into three independent universities in Manchester, Liverpool and Leeds. He was elected a fellow of the Royal Society in 1879, at the early age of twenty-eight years, and always took a prominent part in the work of the Society. He served two periods as an ordinary member of Council and was secretary for seven years (1912–19) embracing the difficult period of the War. On retiring from the secretaryship he served on the Council for five more years, first as vice-president and then as foreign secretary. He received a Royal and a Rumford Medal from the Society, and eventually, in 1931, the Copley Medal. He was also an active member of the British Association, serving as president of Section A (Edinburgh, 1892), of the Sub-section of Astronomy and Cosmical Physics (Belfast, 1902) and finally of the whole Association at Manchester in 1915. It would be tedious to enumerate all the committees, commissions and conferences on which he served; but mention must be made of the Royal Commission for the Universities of Oxford and Cambridge under the chairmanship of Lord Oxford and Asquith, in the work of which he was deeply interested.

There is still another side of Schuster's life to relate, and one to which he devoted the greater part of his time after retiring from the professorship at Manchester. I have already mentioned that Schuster's education had given him complete command of the three main European languages. He was always fond of travel and became personally known to the leading men of science in all parts of the world. Also his family connexions were international rather than national. Thus he was by circumstances, training and temperament eminently fitted to take a leading part in the international organisation of science. It is not surprising therefore that he should be sent by the Royal Society as delegate to the preliminary meeting held at Wiesbaden in 1899, for the organisation of the International Association of Academies. He took an active part in the subsequent formation of that Association and in 1905 was appointed by the Royal Society to be the representative of the Society on its Council. To facilitate Great Britain taking a proper share in the work of the International Association of Academies, Schuster endowed the Royal Society with a fund of £3,500, the income of which was to be used in paying the annual subscription to the Association and in defraying the expenses of delegates.

The War destroyed the International Association of Academies, much to the distress of Schuster; but even before the end of hostilities, he commenced to build up again an international organisation for science by the foundation of the International Research Council, of which he became the first secretary, an office he held from 1919 until 1928. It is impossible here to give any details of Schuster's struggles after the War to re-establish real international co-operation in science; trusted by both French and German men of science, no one was more fitted to bring about an understanding; but circumstances were too strong, and even to-day the breach caused by the War in international co-operation amongst men of science is far from being repaired.

For a man of his outstanding ability and force of character, Schuster was of a very retiring nature. It was not easy to get to know him well; his manner was reserved and he had a disconcerting habit of letting his mind wander—or appear to wander—from the subject of conversation. But all of us who came into close contact with him knew how superficial these mannerisms were: behind them there was a lively human interest and a great desire to help. Few professors took a more active interest in their students, and in this he was ably assisted by Lady Schuster, whose hospitality at Kent House in Victoria Park, Manchester, is a happy recollection of all those who studied under, or worked with, Sir Arthur in Manchester. An outstanding characteristic was Schuster's loyalty to his friends, for he never lost an opportunity of advancing the career of anyone who had gained his confidence. Mention has been made above of three valuable donations which he made in the cause of science; but there is good reason to believe that these are only a small fraction of the contributions he made to scientific objects.

For months it has been known that Sir Arthur could never recover and he has been withdrawn from his most intimate friends; but the passing of one who has had such an influence on the lives of individuals, on the progress of science in his own country and on the attempt to attain international co-operation in scientific matters cannot but come as a shock, and there will be many in all parts of the world who will feel a personal loss in the death of Sir Arthur Schuster. G. C. S.

MR. GEORGE FLETCHER

THE many friends of Mr. George Fletcher will have received the news of his death on September 20 with deep regret and a sense of personal loss. While an electrical engineer on the old Midland Railway, he studied at the Derby Technical School, and soon made his mark as a lecturer of exceptional ability. His success as an organiser attracted the attention of Sir William Abney and led to his appointment in 1894 as inspector under the Science and Art Department. He worked for two years in the west of England and was then put in charge of the Midland Division, comprising many important schools. As an inspector Fletcher was at his best and may be said to have established a new standard of inspection. His personal charm, wide knowledge of the aims and methods of practical studies, and his tendency always to help rather than to criticise, made him universally popular among teachers and colleagues.

On the establishment of the Department of Agriculture and Technical Instruction for Ireland, Fletcher was appointed by Sir Horace Plunkett in 1901 as Chief Inspector, and on Sir Robert Blair's appointment to the post of Education Officer to the London County Council, he succeeded him in the post of Assistant Secretary, Technical Instruction, to the Department. In this capacity he did much to foster the growth of a public sense of responsibility for education, and the local committees under his sympathetic guidance became responsible and progressive bodies.

The recent wide extension of the administrative and rating powers of local committees have been rendered possible by Fletcher's patient work during the past twenty-five years. His many-sided interests made him a constant contributor to educational discussion at international conferences, and at meetings of the British Association.

News and Views

Prof. L. J. Henderson

THE cost of the new University Library at Cambridge, which is to be opened by the King on October 22, was defrayed, in part, from a munificent benefaction given by the Rockefeller Foundation; the rest of that benefaction having been devoted to the development of biological science. It is appropriate, therefore, that the University should utilise the occasion to confer the honorary degree of Sc.D. on two biologists from the United States, Dr. Lawrence J. Henderson, professor of biological chemistry at Harvard University, and Dr. K. Landsteiner, of the Rockefeller Institute for Medical Research. Dr. Henderson comes of that old New England stock from which so much of the flower of Harvard has grown. He graduated at that University in 1898 and has held his present chair since 1919. It is difficult to-day to imagine that at the commencement of the present century, there were no exact ideas about the 'reaction' of biological fluids and that the sign '*p*H' did not exist. To-day, hydrogen ion concentration is regarded as one of the most fundamental conditions which govern the reactions of the body. Henderson had a great hand in this revolution, and especially in the investigation of the balance between carbonic acid and base, by which the hydrogen ion concentration of the body is maintained so close to neutrality. The famous 'Henderson-Hasselbalch equation' stands like a monumental stone testifying to the part which Henderson played. After the War, Henderson concerned himself with a more comprehensive study of the equilibria occurring in blood. The investigation of these centred principally about three groups of factors: (1) the properties of hæmoglobin; (2) the composition of the plasma; and (3) the nature of the membrane which separates one from the other.

IT had been recognised that in the simultaneous presence of oxygen and carbonic acid, the equilibria which hæmoglobin forms with each gas is not independent of the other. Henderson showed, however, the existence of an equilibrium to which eight factors contributed: oxygen, carbonic acid, water, chlorides, serum proteins, serum bases and intracellular bases and hæmoglobin. If the concentration

of any two is altered to a known degree, the whole equilibrium involving the other six could be calculated. These relations he expressed in the form of nomograms in his book "Blood" which appeared in 1928. As the concentrations of the above factors in the blood are largely governed by its surroundings, Henderson's mind was much concerned with the general topic of 'environment', to which subject he made a contribution of great importance in his book "The Fitness of the Environment" (1913). Lastly, Henderson himself appreciated that the blood does not spend long enough in any one set of surroundings for the complete establishment of the equilibria appropriate to them; it is upon this subject that he is giving a short course of lectures on October 16, 17 and 18 at University College, London, and on October 19, 23 and 24 in the Physiological Laboratory, Cambridge.

Tribute to Prof. E. G. Coker

THE retirement of Prof. E. G. Coker from the Kennedy chair of civil and mechanical engineering in University College, London, was the subject of a couple of paragraphs in the News and Views columns of NATURE of August 11. Opportunity was then taken to refer to a few outstanding points in Prof. Coker's career and work, particularly his researches on the use of polarised light in determining the distribution of stress in machines and structures. On October 11, a complimentary dinner was given to Prof. Coker at University College, London, and he was presented with a cine-camera and a cheque by past and present colleagues and students. Lord Rutherford, who presided over a large assembly representing various departments of university teaching and research, recalled the days when Prof. Coker was associate professor of civil engineering in McGill University, Montreal, and he himself was Macdonald professor of physics in the same University. Since then Prof. Coker's pioneer work has been recognised by his election as a fellow of the Royal Society, and by the use of his results in solving many scientific and engineering problems. Prof. L. N. G. Filon, who collaborated with Prof. Coker in the production of the exhaustive treatise on photo-elasticity, published in 1932, added his tribute to that of Lord Rutherford. In his reply, Prof. Coker said that the council of the College has permitted him to take away much of the apparatus which he used in his researches, and that he proposes to continue his work in a laboratory which he has constructed near his home.

Thomas Henry, F.R.S. (1734–1816)

THOMAS HENRY, the senior member of that family of chemists whose exploits won for them no mean place in the history of the science, was born at Wrexham on October 26, 1734. On leaving the local grammar school, he was apprenticed to an apothecary at Wrexham, but completed his initial training at Knutsford, and afterwards became chief assistant to a Mr. Malbon at Oxford. In 1759 he returned to Knutsford, and in 1764 established himself as an apothecary in Manchester, where he continued in practice for almost half a century. Notwithstanding his extensive practice, he was an ardent experimentalist and ambitious to extend the boundaries of chemical science. His numerous publications testify to his wide interests and his unremitting labour, "An Improved Method of Preparing Magnesia Alba", "Experiments on the Influence of Fixed Air on Vegetation", "Experiments on Ferments and Fermentation", and "The Nature of Wool, Silk, and Cotton as Objects of the Art of Dyeing" being a selection of the papers he communicated to learned societies. To-day his name is, perhaps, chiefly associated with "Henry's Calcined Magnesia", a preparation patented by him which is still on the market. Henry was elected a fellow of the Royal Society in 1775 on the recommendation of his friends Sir John Pringle, Joseph Priestley, and Benjamin Franklin. On the foundation of the Manchester Literary and Philosophical Society in 1781, he was elected one of the secretaries, and was the president from 1807 until his death in 1816. He was a keen educationist, and gave lectures in Manchester on chemistry and on bleaching, dyeing, and calico printing. Henry was essentially a practical man. He saw the need for the application of chemical knowledge to the arts and crafts, and in attempting to meet that need did much towards paving the way for the union of pure and applied chemistry.

Chemistry in Industry

BRITISH chemical industry has in recent years been the subject of political discussion, of Governmental action, and of no little anxiety among those who realise the effect which duties, quotas, restrictions, and the like may have for better or for worse on a great national enterprise which has scarcely reached adolescence. In a world of such complex economics, the necessity of an organisation whereby exchange of views and corporate action are facilitated becomes at once apparent, and it is therefore not surprising that the Association of British Chemical Manufacturers finds its activities and its responsibilities increasing year by year. In moving the adoption of the Council's report at the annual general meeting of the Association, held on October 11, the chairman, Mr. F. H. Carr, referred at some length to its activities, its extending influence, and its increasing membership. There has been an unusually heavy loss by death of leaders in the industry; reference was specially made to the late Sir Max Muspratt, a founder and a wise counsellor who played a great part in the development of British chemical industry and contributed in no small degree to the strength and reputation of the Association. By the service of Sir Max Muspratt and many men of like character and attainments, and by the devotion of the staff, the Association to-day finds itself able to protect the interests of British chemical manufacturers to a degree undreamed of when it was first formed. Its membership roll now includes no fewer than one hundred and eleven firms, and other applications are pending.

EXHIBITIONS and fairs are always a source of concern to firms which have to consider how far the results attained justify substantial expense. The Association of British Chemical Manufacturers, not unmindful of the fact that the key industry duties on fine chemicals will, unless removed, expire in 1936, urges manufacturers to exhibit at the forthcoming British Industries Fair in order to show the general public and those in authority how great and wise a use has already been made of that protection. Recent trade statistics show a marked increase in the importation of chemical products which are made in Great Britain; chemical exports have also increased, but to a smaller extent. Doubtless there is ground for investigation whether the best use is being made of our tariff system, for further attention by manufacturers to the necessity of endeavouring constantly to increase the attractiveness of their products in the world's markets, and for greater consideration by buyers of the claims, *ceteris paribus*, of home manufactures. The Ottawa agreements have benefited the chemical industry in many directions, although certain unexpected difficulties have arisen. Mr. Carr warned his audience that if the Ottawa idea is to be continued and expanded, there is an urgent need for the economic planning of agriculture and of industry in the Empire. Consideration has lately been given also to the position of the chemical and allied industries in relation to Government-owned patents, and a scheme of co-operation with the Department of Scientific and Industrial Research and the British Chemical Plant Manufacturers' Association has been evolved. Other sections of the report or of the chairman's address referred to safety measures, transport, poisons rules, the fine chemical industry, and the dyestuffs industry.

The Government Laboratory

REPORTING on the work of the Government Laboratory for the year ended March 31, 1934 (London: H.M. Stationery Office, 1934. 9*d*. net), the Government Chemist, Sir Robert Robertson, refers *inter alia* to the frequent necessity for investigating work in connexion with chemical tests on imported goods and articles of commerce. He briefly summarises the results of tests applied to dairy products, and once again mentions that there is no standard, as regards fat content, for cream in Great Britain, and no regulations relating to the marking of skimmed or partially skimmed milk cheese. A curious incrustation on the surface of stored marine shells was found to consist of calcium acetate. The shells had been stored in drawers of oakwood, which is known to evolve traces of acetic acid continuously, and the effect was attributed to the localised action of acetic acid attracted by the deliquescent residue from sea-water salts. Among the great variety of duties performed by the Laboratory during the year, in addition to numerous analyses of foods, drugs, fertilisers, water, beverages, dyes, oils, silk, etc., were the restoration of medals and plaques for the Imperial War Museum, detection of the fraudulent use of stamps, a search for the cause of earthy flavour in fish, complete analyses of rocks for the Geological Survey, the recovery of radium from decayed luminous paint, and the examination of materials purchased for the public service.

Whale-Marking in South Georgia

IN view of the complete lack of accurate knowledge on the migrations of whales, the "Discovery" Committee has for the past nine years been conducting experiments in whale-marking. The only practicable method of marking is by shooting a mark into the blubber from a gun. In the first series of experiments the mark used consisted of a barbed pin attached to a disc designed to lie flush with the surface of the body. Numbers of whales were marked by this means, but no marks were returned from those engaged in the whaling industry. At the Marine Biological Station in South Georgia it was found that *Pennella*, a parasitic copepod which infects whales in temperate and sub-tropical regions, was rapidly extruded from the blubber when the whales visited the cold waters of the Antarctic, and since this parasite is very firmly anchored in its host, it is practically certain that the whale marks were extruded in the same way. Another pattern of mark was devised—a short length of stainless steel tubing fitted with a leaden head. This mark is designed to embed itself completely in the blubber; when once the wound of entry has healed, the mark cannot fall out, and it will be found without difficulty by the whalers when the blubber is stripped from the carcase. Experiments conducted with this pattern give promise of success: five of the marks used have been recovered, three after the lapse of a few weeks and two after thirteen months. In no case was there any sign of suppuration, and in some the wound could not be found. All the whales were in good condition. The Committee is now undertaking whale-marking on a larger scale. One of its scientific staff, Mr. A. H. Laurie, left England in September to carry out the work in South Georgia, and on October 16 the R.R.S. *William Scoresby* left for the whaling grounds off Bouvet Island and Enderby Land on a whale-marking cruise. Mr. G. W. Rayner, who has conducted many of the earlier experiments, is scientific officer in charge, with Lieutenant C. R. U. Boothby in executive command.

National Trust's New Property in Derbyshire

BY the generous gift of Mr. F. A. Holmes of Buxton, announced on October 10, Stanton Moor Edge, near Rowsley, Derbyshire, becomes the property of the National Trust. This body is already the owner of three properties in the immediate neighbourhood, Shining Cliff Woodlands at Ambergate, Duffield Castle and Taddington Wood. The new acquisition consists of 28 acres and is an escarpment, 900 ft. above sea-level, which forms a natural terrace a mile in length, looking out over moorland and the valleys of the Wye and Derwent. Not only is the view from this escarpment of great natural beauty, but it is situated in the middle of an area of exceptional interest for the historian and archæo-

logist. It has been a centre of human habitation from the stone age onward and is one of the principal centres in Great Britain of the civilisation of the early bronze age, when it appears to have been thickly populated. In addition to the evidence of stone circles, round barrows and other monuments in the area, the culture of the district is to be studied in the rich and varied collections of funerary pottery, implements, weapons and ornaments of stone and bronze, which are to be seen in the museums of Buxton, Derby and Sheffield. Mr. Holmes, in addition to this generous gift, has shown his interest in the preservation of the antiquities and natural beauties of his county by his association with the efforts which secured the other Derbyshire properties for the nation, as well as by his work as chairman of the Buxton Committee of the Council for the Preservation of Rural England.

Stenhouse Williams Memorial Library

On Saturday, October 13, the library erected at the National Institute for Research in Dairying (University of Reading), to the memory of the first director of the Institute, Dr. R. Stenhouse Williams, was opened by the Minister of Health, the Right Hon. Sir E. Hilton Young, in the presence of numerous guests, presided over by the chairman of the Board of the Institute, the Earl of Iveagh, and including subscribers to the memorial fund, members of the University of Reading, and others directly interested in dairy science or the Institute. Sir Hilton Young said that it was particularly gratifying to him as H.M. Minister of Health to assist in celebrating this step forward in the development of one of the most essential health services. Milk has a unique place in the dietary of the people, and although its consumption is relatively low, there has been in recent years an increasing understanding by the public of the value of milk in nutrition. He emphasised the importance of research in increasing the consumption of milk and improving the methods of production, and paid a tribute to the great pioneering activities of Dr. Stenhouse Williams in the field of dairy research, and in the development of the Institute. A library is an absolutely essential part of the Institute. Its foundation is, however, but a beginning : it needs not only the original but also the continued benevolence of the community. All present would remember with gratitude those who have combined to bring this memorial into existence in so appropriate and so efficient a form, and particularly they would think of the man who would continue to be an inspiration to those who came after him. It was stated that the Library building has cost approximately £3,000 and that present contributions to the memorial fund amount to £2,300.

The Maison de la Chimie in Paris

The opening of the Maison de la Chimie on October 20 in Paris marks the completion of the first step towards a comprehensive scheme of centralisation of chemical bibliography and other scientific activities. The Maison de la Chimie had its origin in the celebration of the centenary of Marcelin Berthelot in 1927, when a sum of twenty-five million francs was collected by international subscription. The French Government presented a historic building—the house of La Rochefoucauld—d'Estissac, rue St. Dominique, near the Chamber of Deputies. This has been reconstructed and extended to house a library equipped with the latest facilities. Large halls for meetings of scientific societies and congresses have also been provided. Indeed, this is a special feature of the project, and the opening of the building by M. Lebrun, President of the Republic, is to be followed by the holding therein of the fourteenth Congress of Industrial Chemistry (October 21–27). M. Jean Gerard, administrator of the Maison de la Chimie and Secretary of the International Union of Pure and Applied Chemistry, hopes to develop the present centre into a "Maison de la Science" where international congresses in all scientific fields can meet and be assured of the services of a staff accustomed to the organisation of congresses. All those who have attended international gatherings know that the standard of efficiency with which they are run varies considerably, and that a little more attention paid to the purely technical part of their organisation would often add considerably to their scientific value. We may therefore wish M. Gerard all the success that his plans deserve.

Iraq Oil reaches Haifa

The construction of the Iraq Petroleum Company's pipe-line to convey oil from the Mosul oilfields to the Mediterranean seaboard is an engineering feat of no mean importance and one which has been watched with keen interest by petroleum technologists and engineers all over the world. Its real completion may be said to have been achieved at 2.30 a.m. on October 14, when the first stream of oil pumped from the fields reached Haifa ; according to the *Times* it is anticipated that the first shipments of oil will be made before the end of October. The pipe-line stretches for nearly 1,200 miles over extremely difficult country, much of which is desert. It runs from Kirkuk to Haditha, where it bifurcates, and the southern (British) line follows through Transjordania and reaches the pipe-line terminal at Haifa. The actual pipe-line was completed in 1933, since when most of the engineering work has been concerned with the installation of the necessary boosting stations *en route*. With the delivery of oil to the seaboard, it may be confidently asserted that the pumping installations have proved their efficiency and that the regular flow of oil will now become a routine matter. We have as yet no information as to whether oil is being diverted along the French line, that is, through Syrian territory to Tripolis, but doubtless this will also soon be an accomplished feat. The influence of this oil now made available to European refineries will be considerable, and will undoubtedly affect both the political and economic aspects of the petroleum industry within a comparatively short space of time.

Scientific Meetings and the Public

MR. T. SHEPPARD, director of the Municipal Museums, Hull, contributes to the October issue of the *Naturalist* some notes on points of interest connected with the recent meeting of the British Association at Aberdeen. In a paragraph on "Lectures and Lecturers" he says, "We have complained over and over again of the apparent inability of many of the lecturers to give audible and understandable discourse"; and he refers to the plea made at the meeting by Mr. H. T. Tizard, and on many other occasions, for increased care by scientific workers in speech and writing. Unfortunately, some authors of papers seem to be unaware of the most elementary principles of speaking to an audience. If they read their papers, they speak to the desk with their heads down, and if they use blackboards or diagrams they turn their backs to the assembly. While research is being carried on into the conditions of good acoustics in buildings, and architects are criticised for not taking these conditions into consideration, many scientific men would apparently not trouble to make themselves heard in the most perfectly designed building; and even when a microphone is provided they turn away from it. In a communication to a scientific society, inability to speak with ease is perhaps pardonable when an investigator is presenting the results of original research to other workers in the same field. The British Association, however, "seeks to promote general interest in science and its applications". No technical qualification is required for membership, and every year the public is invited to join and attend the meeting. There are thus particular reasons why speakers in the section rooms or elsewhere should remember the character of the assembly they are addressing. Whatever the nature of the audience, however, if an author is not prepared to take the trouble to make himself audible and intelligible, he should not be permitted to irritate his hearers and his paper should be 'taken as read'.

Science and Social Reconstruction

IN the eighth Steinmetz Memorial Lecture delivered before the Schenectady Section of the American Institute of Electrical Engineers on January 10, Dr. C. E. Kenneth Mees, under the title "Scientific Thought and Social Reconstruction", endeavoured to assess the contribution which men of science can make to the solution of our social and economic problems. While the lag between a scientific discovery and its application tends to decrease and consequently the rate of change produced by scientific knowledge to increase, he does not think that the rate of change will continue to increase. It is highly probable that our social system is in an unstable phase, but after a period of rapid change in which the state of strain is relieved, it should settle into a new and stable phase. While admitting that the man of science must be actively concerned with the vast social and political experiments of our time, Dr. Mees does not consider it would be wise for him to take up the burdens of the politician. He believes that the chief contribution of science to social reconstruction is the method and spirit in which the scientific worker approaches his own work of creating ordered knowledge which is then available for all.

THE transformation of technical industry in the last twenty years is due as much to the growth of the scientific spirit in all sections of the industrial organisation as to the actual laboratory work, and a like transformation in government is required. The use of the scientific spirit in Government would be effectively promoted by scientific men expounding insistently the nature of scientific thought and studying its application to our social and political problems. Discussing the part played by emotion in politics and the opposition between science and arbitrary authority, Dr. Mees insisted on the necessity for some appreciation on the part of men of science of the impossibility of leaders of a democracy being entirely scientific in their attitude. The transformation of industry already indicates the possibility of orderly evolution, and problems of social reconstruction could ultimately be dealt with in the same way as other problems, if men of science set themselves continuously to assist in the wise selection of leaders and in the education of the community as to the meaning of the scientific method and spirit.

Vocational Guidance and Juvenile Employment

THE National Advisory Councils for Juvenile Employment have issued a joint report on the organisation and development of the vocational guidance services in Great Britain (H.M. Stationery Office). The report gives the history of the national scheme for advising boys and girls on the choice of employment. The first attempt on a national basis dates from the Labour Exchanges Act of 1910, when special provision was made for young applicants. It is estimated that probably one in every four of the total number of engagements of juvenile staff is effected through the official organisations of the local committees for juvenile employment. The methods by which advice is given on industrial and kindred matters fall into two divisions—collective and individual. The former includes lectures, visits to factories, display of films and slides on industrial subjects. Individual advice is given to more than a quarter of a million boys and girls, so that roughly rather more than one in three receive expert advice before entering upon initial employment.

THE basis of all sound vocational advice is the alliance of the teachers' knowledge of the individual juvenile's educational and personal capacity with the industrial knowledge of the juvenile committees. The hope is expressed that there should be a reconsideration of the form of the school-leaving report so as to make it more adequate. Finally, in this connexion there is a survey of the experimental work in industrial psychology as an aid to vocational guidance. The principal published experiments are given in an appendix, and consideration of the claims made leads the authors of the report to the conclusion that "the application of psychological methods to

vocational guidance should still be regarded as at the experimental stage" though "sufficiently encouraging to justify the continuance of experiments". It is therefore recommended that the Industrial Health Research Board in co-operation with the Ministry of Labour should carry out further experiment. Various suggestions are made for the coordinating of existent services and for a better interchange of information between the various bodies concerned.

Present and Past World Problems

DR. NICHOLAS MURRAY BUTLER has been protesting, in an address delivered at Columbia University's summer session convocation on August 7, against the absurdity of treating the world problems of our time as if they were unprecedented—as if there had been no tests in the past of theories and ideals of social, economic and political life as applied to conditions fundamentally similar. Between 1776 and 1789, the thirteen American States faced every single problem which the nations of the world face to-day. What those sovereign States were doing then, indulging in internecine tariff wars, boycotts, export prohibitions, pandering to short-sighted prejudices and particularist passion, the sovereign nations of the world are doing now. The substantial identity of the problems and of the futile tactics with which it was sought to circumvent them are illustrated by passages quoted from the works of F. S. Oliver and John Fiske and from State papers. It was Alexander Hamilton who, combining an acute intelligence, assiduous study, varied experience, indomitable courage, tenacity of purpose, persuasive eloquence and whole-hearted devotion to ideals, saved the States from the ruin towards which they were drifting, and it is by the application of the spirit of his policies to the needs of the nations of the world to-day that these may yet be saved from the world chaos with which we are threatened. The title of the address is "The World needs another Alexander Hamilton".

Work of the Meteorological Office

THE annual report of the Director of the Meteorological Office for the year ended March 31, 1934 (London: H.M. Stationery Office. 1s. net) is on the same general lines as previous reports, but is somewhat longer, numbering sixty pages; this expansion has its counterpart in an all-round increase in the activities of most of the different sections of the Office, in particular as regards the number of persons or institutions that were supplied with meteorological information, particulars of which are given in the report. In one respect, however, this report differs from those of recent years; it is made more self-contained by a modification of the introductory matter into a fairly detailed exposition of the normal work of the Meteorological Office, especially that part of it connected with synoptic meteorology which involves the collection of data broadcast by foreign countries and by ships at sea, and the supply of such data for the British Isles and neighbouring seas in return; little or no knowledge of such matters is assumed on the part of the reader. The statistics relating to the work performed in response to external demands for information show in some cases a striking rate of increase; for example, the forecast service dealt with 10,166 inquiries for the Press compared with 8,705 in the previous year, an advance that cannot wholly be explained by the abnormal weather of 1933–34, although this was doubtless partly responsible for it. In the section concerned with British climatology, where inquiries about past weather, some of which are of a very detailed character, are dealt with, the number of such inquiries was 2,222, and it is stated that in comparison with the annual figure ten years back, this represents a six-fold increase. The report not only summarises the activities of the branches of the Office at headquarters, located in Kingsway, London, and at Exhibition Road, South Kensington, but also those of the observatories and of the branches in Scotland, Malta, Egypt and Iraq.

Co-operation between Aeronautics and Meteorology

AN interesting case of co-operation between scientific workers to their mutual advantage is revealed in the annual report of the Meteorological Office. The Royal Air Force has established a meteorological flight at Duxford Aerodrome, Cambridge, which consists of two aeroplanes with the necessary pilots and ground staff. Their particular duty is to collect information regarding the upper air, and flights are made daily to heights of 25,000–30,000 feet. These flights often involve penetrating cloud layers several thousands of feet thick, and such is the keenness of the station personnel that more than 90 per cent of the scheduled flights have been completed during the past year. Information developed from this is prepared specially for civil flying and distributed from such centres as Croydon. The report states "The rapid growth of flying in and above clouds on the Continental air routes, and the practice of following a direct compass course between the terminal aerodromes, have necessitated the forecasting of much more critical conditions than formerly. Consequently the work at Croydon has become highly specialised and necessitates forecasters of considerable experience of the peculiarities of these air routes, which—in the opinion of pilots of wide experience—are the most difficult from a meteorological point of view of any in the world". 336 gale warnings were issued during the year, of which 81 per cent were justified. It has also been established that there is a fair measure of agreement between the frequency of thunderstorms and the occurrence of sunspots in high northern and tropical latitudes, though not so marked in the temperate zones.

Biological Field Station near Sydney

THE Sydney University Biological Society has recently opened a field research station at Narrabeen, the erection and fitting of which was accomplished at a very modest cost by members of the Society and of the Sydney University Rover Scouts; the building

(*Continued on page* 623.)

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Reviews

A Monument of Lexicography

Webster's New International Dictionary of the English Language. Second edition, unabridged. Pp. xcvi+3210. (London: G. Bell and Sons, Ltd.; Springfield, Mass.: G. and C. Merriam Co., 1934.) 84*s*. net; with Thumb Index, 90*s*. net; 2 vols., 85*s*. net; with Thumb Index, 90*s*. net.

THE appearance of the long-anticipated second edition of "Webster's New International Dictionary" is an event of considerable and pleasurable importance. "Webster" is *sui generis* —inimitable in conception and unexcelled in achievement—and has won, on its merits alone, a place of pre-eminence in a world by no means ill-provided with dictionaries of high rank. Comparisons, we know, are odious, but since the thought of the great "Oxford English Dictionary" must be present in every English-speaking mind as that of the supreme exemplar of lexicography, it is necessary to inquire at once into the relation between that majestic work and the "New International Dictionary". A very practical difference lies in the disparity of prices, for, even in the form of its cheaper reprint, the O.E.D. is beyond the pocket of the average man, while "Webster" costs no more than a weatherproof. A second utilitarian difference is in the disparity of sizes, for while even the smallest study or office could accommodate "Webster" (which might indeed stand permanently on the corner of a desk), the O.E.D. spreads itself luxuriantly over several feet of shelf-room. We do not, of course, quarrel with either bulk or price when the former is so worthily filled and the latter so fairly set as in the O.E.D.; but when we buy a dictionary they are considerations of immediate concern.

It is, however, not in corporeal or financial respects that the crux of the contrast lies. The O.E.D., if we may so put it, is a dictionary primarily for the scholar, while "Webster", though thoroughly deserving the epithet of 'scholarly', is designed for the educated, practical citizen of the world; it is, in fact, considerably more than a dictionary and approaches the character of a vast encyclopædia in miniature. To take an example in point: if we have occasion to look up the word 'boo k binding' it is scarcely likely to be for the purpose of discovering the meaning of the term, and "Webster" intelligently anticipates the probable reason by giving a concise table of the principal bookbinding styles, with their dates, their characteristics, and particulars of the persons by, or after whom, they were named. In the same way, under the word 'coin', we find not only the etymology and meanings of the word, but also a lengthy list of the principal current coins, with their equivalents in (*a*) other native coins, (*b*) U.S. currency and (*c*) British currency; while a double-page coloured plate of some seventy or eighty coins forms an admirable complement to the text of the entry.

A typical example of the treatment of a scientific word is to be found under 'chlorine', where, after the pronunciation and etymology of the name, the chief chemical properties, physical constants and uses of the gas are succinctly mentioned. Important scientific topics are given the dignity of a column or more: thus 'element' has nearly two columns (including a list of the elements with their symbols, atomic numbers and atomic weights); 'fruit' has nearly a column, with a scheme of classification of fruits and a chart of the more important varieties; 'colour' has three columns with two coloured plates; and if 'palmistry' has a longer entry than 'physics' the occasion is merely one for congratulation on the part of the palmist, not for complaint on the part of the physicist. The latter, indeed, will discover that he has been provided for with noteworthy efficiency—photon and proton, neutron and positron, quantum and millicurie, and a thousand physical terms, are defined with a precision that leaves nothing to be desired. Other branches of science are accorded the same comprehensive and intelligent attention, with a success that must make "Webster" an indispensable companion to the scientific worker.

In its more general aspects, the dictionary is equally comprehensive, accurate and concisely informative. Much as we may regret them, for example, there are numerous slang words and phrases the meanings of which we find it necessary to know; and if they are of any wide circulation,

"Webster" will almost certainly be found to have included them. There are, however, a few curious omissions in this respect, for while "sex appeal" is decorously defined, "glad eye" is unaccountably absent, and though "kick the bucket" is equated to "to die" there is no mention of "conk out". These omissions, we may readily agree, are more than balanced by the welcome inclusion of such good English dialect words as "dither" and "nesh", "drang" and "toot" (in the sense of a small hill).

The pronunciation of words is clearly indicated, and, in many cases, where the American pronunciation differs from the English, both are given—for example, under 'schedule' (skĕd'ul and shĕd'ūl)—though occasionally the American form only is noted. The etymology is scholarly and conservative, and in those test instances that we have applied to it (for example, Whitsuntide, pea, grobel) has always been correct.

Among the remaining features of the dictionary are a biographical section of more than 13,500 names of noteworthy persons (sufficiently up to date to include Herr Hitler), a pronouncing world gazetteer of some 30,000 places, a table of forms of address, a very useful section on arbitrary signs and symbols, a lengthy list of abbreviations in common use, plates of national flags, a history of the English language, modestly described as brief, and a guide to pronunciation. The book is profusely and appositely illustrated, and many of the principal words are provided with antonyms and synonyms. It would, indeed, be difficult to suggest any improvement, even in detail, and the editorial board, printers and publishers are to be unreservedly congratulated on the production of a superb example of lexicography. They have placed the whole of the English-speaking world under a lasting debt to them; and they should feel happy in the thought that "Webster", re-invigorated and reinforced, has once more undertaken its task of universal service. The dictionary-maker is no longer 'a harmless drudge'; he is a vital factor in the advance of learning and the progress of civilisation.

E. J. HOLMYARD.

British Neolithic Man

The Skeleton of British Neolithic Man: including a Comparison with that of other Prehistoric Periods and more Modern Times. By Dr. John Cameron. Pp. 272+16 plates. (London: Williams and Norgate, Ltd., 1934.) 15*s*. net.

THIS book is clearly the result of long and careful work by Dr. Cameron. It is a digest, more or less complete, of the state of our knowledge of prehistoric man compared with that of the man of historic times, down to the present day. It is not, I think, a book meant for the general reader, nor would it mean much to him; but to the serious worker in anthropology, who is able to distinguish its strong from its weak points, it will be very valuable, and it is sure of a place in every scientific library.

The amount of original work which the author has put into it is not very large, and with what there is I cannot always agree. The new theories to account for platymeria and platycnemia, for example, would be all the better for discussion and criticism at the Anatomical Society, where they would have to run the gauntlet of men who are handling bones, and the muscles which mould them, every day.

All the standard indices, angles and arcs are dealt with, one by one, and those of the Neolithic people are contrasted with those of other races which have inhabited, or are inhabiting, Great Britain; but what the author has not done—possibly because he assumed that his reader knew it already—is to point out that if all these are put together, they will not produce average pictures of the skulls of the different peoples examined; indeed they often produce skulls so grotesque that even a layman would laugh at them.

I am very grateful to Dr. Cameron for his kindly mention of so much of my work but I would exchange it all for a passing reference to the average skull contours, derived from series of horizontal and vertical measurements of dioptographic tracings, published in "Early Man" by the Royal Anthropological Institute. A glance at these would show how completely Mr. Macdonell was misled by thirteen indices into stating that the seventeenth century Londoner was a Neolithic man; for the modern Londoner's contour has been worked out and may be placed side by side with that of the Neolithic people, and it does not need an anatomist to see how utterly different they are.

Then again, it is a pity that Dr. Cameron chose the Hythe skulls as types of medieval Englishmen, for they differ from all our other medieval skulls, at Rothwell, Dover and Upchurch, in being those of a settlement of round-headed people who must have come into England from the Continent in the thirteenth or fourteenth century, and resemble the Mid-European type very closely. The typically English collection from Rothwell would have served his purpose so much better.

I have given the book this serious criticism because I think that it is worth it, but I must not forget to add that perhaps the part which will be most useful of all is the list of ancient skulls in the different museums of Great Britain; for which, I gather, we have largely to thank Miss Tyldesley.

F. G. PARSONS.

The Folk-Play

The English Folk-Play. By Sir E. K. Chambers. Pp. vii+248+2 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 10*s.* net.

DURING the last thirty years, considerable attention has been given to the English folk-play. When in 1903 Sir Edmund Chambers attempted an account of the 'mummers' play' in his book "The Medieval Stage" only twenty-nine examples were available: in the present work he has drawn upon well over one hundred and there may be, he thinks, others which have eluded his search. This form of rustic entertainment had, in fact, almost died out, when it was revived as a result of antiquarian research.

From many points of view, the English mummers' play merits attention, especially now that it is possible to appreciate that it is not an isolated phenomenon, but may well be one manifestation only of a folk-drama which can be traced back with some show of probability to a fundamental religious conception once wide-spread among European peoples.

In essence, the structure of the English folk-play is uniform, wherever recorded. From the various versions available, Sir Edmund Chambers has reconstructed a norm. It cannot, it is true, be regarded as representing the archetype, which probably is not now recoverable; but it does serve to help in restoring the form, and at times the text, of corrupt versions. The play opens with the entrance of a presenter, the personage who announces the principal characters in turn as they enter, each then making a self-descriptive speech. The principal characters, St. George, the 'antagonist' and the Turkish knight, or Capt. Slasher, the 'agonist', then fight and the latter is slain. A doctor appears who, after a certain amount of fooling and rough word-play with his assistant, brings the dead man to life again, and the play ends with the *quête*, which may become something in the nature of an afterplay, in the style of a revue, with a miscellaneous collection of characters and little or no connexion with the main plot.

The author gives a detailed account of the variations of the form, personages and text of the play, which, apart from its main purpose, affords a revealing insight into the peculiar working of the English rustic mind. Changes due to the desire to be topical are frequent. Hence the appearance among the characters of personages now historical, such as Napoleon, or a suffragette "with clogs on my shoulder". Sometimes the presenter is Father Christmas, and the agonist—a point of importance for the history of the play—the dragon slain by St. George. Learning by oral transmission is responsible for numerous textual variations, many puzzling and some amusing. "Rantantorious" for "Pandora's box" is not the least striking.

It is curious and instructive to find that an apparently purely rustic production is not free from the influence of the legitimate drama—a point which should be noted by students of the folk-tale in debating the question of literary sources. Congreve's "Love for Love", for example, is one of several plays that are cited. This contact is to be traced to itinerant players. Nor does extraneous influence appear in matters of detail alone. Sir Edmund derives the traditional antagonist and agonist, St. George and the dragon—when there is a dragon—from the sixteenth century vogue of St. George which found expression in Richard Johnson's "Famous Historie of the Seven Champions of Christendom" of 1596. Before that date, there is clear evidence for only one drama in which St. George appears. This was at Lydd in 1456.

In considering the question of origin, it might be thought that if it has been shown that the traditional centre of interest, the combat between St. George and the dragon or the dragon's substitute, has been traced to a sixteenth century literary origin, the problem is solved. This, however, is not the case, for it does not account for the several elements of the play, such as the woman, the fool, the doctor and his cure, and the most remarkable and pivotal incident, the revival from death. These belong to a remoter antiquity.

The clue lies in the seasonal character of the plays. They were performed at Christmas and, exceptionally, at Easter and the beginning of November, at All Souls. In Lincolnshire and Nottinghamshire, where the killing is loosely associated with a wooing melodrama, the plays belong to Plough Monday at the beginning of January, the day on which agricultural operations are resumed ceremonially after the rest period of Christmas. This seasonal association brings the plays within the category of the seasonal observances and festivals of Europe celebrating the death of the old year and the birth of the new year—the ancient European fertility drama of which the various forms have been described and analysed by Sir James Frazer in "The Golden Bough". The nearest parallel to the English mummers' play is recorded in the Balkans and Greece; but here the fertility motif, which, except in the presence of the woman and possibly in the buffoonery and jesting of the fool, has disappeared from the English form, is preserved in the presence of the phallus and the obscene actions of certain male and female characters.

An interesting point is raised in connexion with

the plough-plays. As has been mentioned, in these the 'killing' is loosely connected with a 'wooing' drama in which one or more suitors seek the hand of the woman. Sometimes there is no killing. Sir Edmund suggests that here we may see the merging into one of two separate classes of drama. The form occurs, it is to be noted, in an area of marginal distribution of the normal mummers' play, where indeed there also appears a connexion with the sword dance, the seasonal festival performance which in the north of England takes the place of the mummers' play. It would be of interest to inquire whether there is any evidence that the 'wooing' is a development of that sexual side of the original rite which has dropped entirely out of the mummers' play. Many of the seasonal festivals, such as the traditional Games of Ireland, and the agricultural festivals of China—perhaps a far cry—preserved this tradition by being the recognised occasion of betrothal and marriage.

The interest of the broader issues raised by this study of the folk-play must not be allowed to obscure its excellence as a record and a study of what the folk-play is or has been as a form of popular art. Both from this aspect and as an examination of the facts pertinent to its ritual origin, Sir Edmund Chambers' book is likely to stand as final.

History of Wheat in Great Britain

Wheat in Great Britain. By Dr. John Percival. Pp. 125+63 plates. (Reading: The Author, Leighton, Shinfield, 1934.) 10*s.* 6*d.*

PROF. PERCIVAL has long been known as an able student of wheat, and an assiduous collector of its different varieties. He has not been content with obtaining ears as herbarium specimens, but has grown them so that he could study their habits of growth and compare them when placed under similar conditions. The work was at first arduous and discouraging: an older generation of Wye College students remembers him rising at 4 a.m. on summer mornings to keep the sparrows off his ripening corn. But he continued undaunted, and as a result has produced in succession sets of a remarkably extensive collection of wheat varieties suitable for colleges, a monograph which has now become the standard one on the subject, and this book which, though small in size, is packed with interesting information and is very fully illustrated.

Prof. Percival has always been able to present a subject well, and he uses this gift to great advantage in the present book. Starting from the earliest finds of wheat in Britain, grains apparently of a primitive type of *Triticum vulgare* found at Hembury Fort, Devon, in 1931, which seem to be definitely of Neolithic Age and dating back perhaps to 2000 B.C., he reviews in succession the later finds: grains resembling emmer (*Triticum dicoccum*) found in an early Bronze Age barrow, and a primitive form resembling *T. Spelta* found at Meare, the late Iron Age settlement in Somerset dating from about 150 B.C. So he goes on right through to modern times, telling us on the way a great deal that is interesting about the history of bread and of milling.

An important section of the book deals with the cultivation of wheat and the effects of climate and other conditions on its growth. Good use is made of the Rothamsted data on the subject, which are now very extensive. The methods of improving wheat are given in sufficient detail for most purposes, and the results are set out at greater length. Finally, there comes an account of the wheat varieties that are or have been grown in the British Isles. Here we miss a few that have figured in the history of agricultural science: Old Red Lanmas, the first variety to come under scientific experiment in Great Britain, being used on Broadbalk presumably because it was a standard sort on the wheat lands of Hertfordshire in the 1830's; Red Cluster, that followed it for a time, and Red Rostock, which was retained all through the palmy days of the 1850's, '60's and '70's. But these have long passed away and all the important kinds grown now or in living memory are here.

Altogether the book can be strongly commended to botanical and agricultural students as a compact summary of much information that they will not easily obtain elsewhere. E. J. RUSSELL.

Quantitative Plant Ecology

The Life Forms of Plants and Statistical Plant Geography: being the Collected Papers of C. Raunkiaer. Pp. xvi+632+53 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 35*s.* net.

A GREAT deal of the literature of ecology is of a purely descriptive character, and it is not perhaps too much to say that many accounts of plant communities which are published to-day, if they add something to our information, add little to our knowledge. Such descriptions are too often the mere multiplication of examples, the working out of the same ideas upon other material without any enlargement of the philosophical concepts involved. Not the least of the debts which we owe to the Danish school of plant geographers and ecologists is that they have not been content to be merely imitators, but have extended the boundaries of our knowledge. In

particular, we owe to Warming and Raunkiaer the recognition of the importance of autecological studies of which biology stands in such need to-day. But to Raunkiaer we also owe the application of exact quantitative methods to the analysis of vegetation and the statistical treatment of plant communities. The translation of Raunkiaer's works into English is therefore particularly welcome, since the original papers written in Danish have only been known to many workers from summaries.

Raunkiaer's name is chiefly associated with the concept of the biological spectrum representing the percentage frequencies of the various types of adaptation to an unfavourable season present in the flora of any area, whether it be a geographical region or the sample of a plant community. Raunkiaer was able to demonstrate that different climatic regions are characterised by different biological spectra, the arctic, for example, being the region of chamæphytic vegetation, the north temperate region that of the hemicryptophytes, the tropics the region of trees and shrubs, whilst deserts are characterised by the high proportion of therophytes.

The quantitative analysis of plant communities forms the subject of the papers presented in Chaps. vi and ix of the work under review. The value of the author's biological classification is illustrated by the study of the vegetation of newly developed soil, of that of the arctic and antarctic, and of that of the Mediterranean region. But, whether the conditions of the environment be edaphically or climatically distinct, Raunkiaer was able to demonstrate that the 'biological spectrum' was correlated with the climatic complex which the meteorological and soil conditions combine to produce. Other aspects of Raunkiaer's wide interests are represented by the chapters dealing with the ecology of *Tussilago farfara*, the influence of types of vegetation on soil acidity, and the nitrate content of *Anemone nemorosa*. The value of Raunkiaer's emphasis on the necessity for quantitative data in the study of plant geography and ecology cannot be easily overestimated, and this is still true even if we doubt whether some of its particular applications have as much value as he attributed to them.

It is much to be regretted that the followers and imitators of Prof. Raunkiaer have frequently been too perfunctory in the application of the principles which he laid down. Too often it would appear that the categories of the life forms of species have been copied by one author from another without their applicability to the region concerned having been definitely ascertained. The variability of species in this respect is indeed an important indication of the 'plant climate' which such perfunctory studies may completely obscure. If, for example, the status of *Scrophularia vernalis*, cited by Raunkiaer (p. 44) as a proto-hemicryptophyte be true for Denmark, this is of considerable interest, since in Britain *S. vernalis* is a biennial rosette plant. The statement on the following page that *Rubus chamæmorus* is without stolons is clearly an error, and not an example of different behaviour. The fallacy in assuming the constancy of life form for any given species was demonstrated by Raunkiaer himself in his study of *Tussilago*, whilst striking examples have also been furnished by Warming, Allorge and others. Such plasticity should emphasise the value of the study of the biology of individual species and serve as a warning against the formal application of systems of biological classification.

The determination of the life form of a species often involves careful and continuous research, but Raunkiaer in his endeavour to construct a simple system, easily applied, perhaps himself encouraged its formal application. Whilst he divides the phanerophytes into fifteen sub-types of very varying biological significance, no distinction is drawn between winter-green semi-rosette species such as *Anthriscus sylvestris* and summer-green types such as *Laserpitium*. Although frankly recognising the distinction between winter annuals and summer annuals, Raunkiaer nevertheless has one class of therophytes only. Such inequalities in his biological groupings and the fact that for the establishment of the concept of the biological spectrum Raunkiaer was forced to utilise rather inadequate data, possibly led to the view that the determination of the life form was quite easy. Actually, as the reviewer has elsewhere shown, even so simple a matter as whether a species is annual or perennial may only be determinable with considerable difficulty.

Ecologists generally will feel a debt of gratitude to the translators, Dr. H. Gilbert-Carter, Prof. A. G. Tansley and Miss Fausboll, who have rendered the works of Raunkiaer available in English, and to the Danish committee which conceived the plan of their publication and financed the undertaking.

E. J. S.

Pastoral Poisons

The Toxicology of Plants in South Africa: together with a Consideration of Poisonous Foodstuffs and Fungi. By Dr. Douw G. Steyn. (South African Agricultural Series, Vol. 13.) Pp. xii+631. (Johannesburg: Central News Agency, Ltd.; London: Gordon and Gotch, Ltd., 1934.) 47*s*. 6*d*.

IN England, losses of farm animals through the ingestion of poisonous plants in pastures is so infrequent that when it does occur it is apt to

figure as 'news' and to evoke in the Press a gentle stream of correspondence, pleasantly reminiscent, usually interesting and sometimes useful, though not always distinguished by accuracy in technical details. In countries less fortunate in this respect, of which South Africa, Australia and parts of the United States are examples, losses due to the poisoning of stock are a much more serious matter. In general, only cases involving large numbers of animals are reported, so that accurate figures for total losses in any country are not obtainable, but Dr. Steyn quotes an impressive list of examples. Thus, one plant alone, *Geigeria passerinoides*, took toll of more than a million sheep in Griqualand West and the south-eastern portion of south-west Africa in 1929–30.

The Union of South Africa is one of the few countries in which this subject is being systematically investigated and this book, as its title implies, is one result of the experience gained in the course of the work done by the author as head of the Department of Pharmacology at the Onderstepoort Laboratories in the Transvaal. The book falls naturally into two main sections. The first 73 pages deal with the general toxicology of plants, starting with the early history of the 'art of poisoning' as practised in Greece and Rome, leading up to a thoroughly practical discussion of all the chemical, pharmacological and administrative problems involved in answering the apparently simple questions: Is such and such a plant poisonous, and if so what should be done about it ? Dr. Steyn and his colleagues have now answered these questions for a considerable number of South African plants, and the answers, with the data on which they are formulated, are given in the second and larger portion of the book (pp. 74–607).

It is already clear that these plants are divisible into four groups containing as their toxic constituents oxalates, cyanogenetic glucosides or possibly other sources of prussic acid, fluorescent substances causing photosensitisation in animals and specific poisons respectively (cf. NATURE, 133, 972, June 30, 1934). The last-mentioned group shows a tendency to sub-divide generically; species of *Senecio* or ragworts, for example, are liver poisons and, so far as they have been chemically examined, owe their activity to specific alkaloids; the species of *Geigeria* produce 'vermeersiekte' (vomiting sickness), but nothing is yet known as to the nature of the poisonous constituent. On the other hand, substances with a digitalis-like action are more catholic in their distribution and are to be found in genera of both Apocynaceæ and Liliaceæ. The number of plants for which the phrase 'active principle unknown' has to be recorded is still large and, in this direction alone, the South African workers are not likely to lack occupation for some time to come.

The arrangement of matter in this section is botanical and the information supplied under the name of each plant is full and usefully critical. Numerous illustrations are provided and references to all the significant literature are given in an excellent bibliography. As the Right Hon. J. C. Smuts says of the book in his foreword, "It represents years of research work at the Onderstepoort Laboratories and in the field, and forms without a doubt the most authoritative treatise yet written on this important subject". This, as becomes a statesman, is an expression of the practical value of the book to the pastoralist, his scientific advisers and those whose duty it is to deal with the administrative problems involved. The book is, however, also a valuable stimulant to work on biochemical problems, such as the significance of the widespread occurrence of cyanogenetic products in plants, and the extent of variation in a particular type of constituent throughout a genus of plants, to which comparatively little attention has so far been given.

T. A. H.

The Quantum Theory

Wave Mechanics: Advanced General Theory. By Prof. J. Frenkel. (International Series of Monographs on Physics.) Pp. viii+526. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 35*s*. net.

THIS work belongs to the international series of physical monographs that is being issued by the Oxford University Press. Prof. J. Frenkel is responsible for three volumes on the quantum theory. The first, entitled "Elementary Theory", came out two years ago, and was very briefly noticed in Nature of June 17, 1933, p. 860. This is the second, entitled "Advanced General Theory", and the third dealing with certain special problems, such as molecules and collisions, is promised for the future.

The first book of the Oxford series was Dirac's famous work on the quantum theory, and there could be no contrast more complete than that between it and the present books. In Dirac's book the theory is presented in a clear, rather abstract and perfectly orderly manner, no loose ends are seen, the logic is inescapable, and after reading it one cannot see why we were all so stupid as only to have understood the quantum a few years ago. Of course, reflexion shows that it is not really so simple after all, but that is the impression left by the lucid exposition and the extraordinarily powerful and deep symbolism. Here the whole approach is different; it is inductive rather than

deductive, and one may regard the whole work as a commentary on Dirac's, for the use of those who do not take kindly to the deep symbolism. The author aims at making everything physically natural by marshalling all the various arguments, analogies and illustrations together, explaining how they lead to the right results, and pointing out the errors and fallacies of other arguments that would lead the wrong way.

When the late Lord Rayleigh had constructed one of those wonderful instruments out of cardboard and sealing-wax with which he was able to produce results of the highest standard, he used to describe the instrument's not very impressive appearance by saying that it "looked as if somebody had made it himself". This is a book that looks as if somebody had written it himself. To read a chapter is to be led by the hand through all the struggles of the kind that one would have to face alone if one were trying to master an unfamiliar subject out of a rather abbreviated encyclopædia article. Without the help, one would spend much time doing the wrong thing and finding out why it was wrong, wondering why some indirect method was used instead of a frontal attack, not seeing the need for some simplifying assumption, and overlooking the importance of some little qualifying phrase. The present work will spare the reader all such troubles, for he is taken through all the difficulties in detail and everything that can go wrong is explained, as well as everything that does go right.

The work has some of the defects of its merits also, for it reads rather like an incomplete piece of original research ; as it goes along, one is never quite sure what has been proved and what only made plausible, and what were the premises from which the argument started. For these reasons, it is to be doubted if this second volume is suitable for an introduction to the subject (though the same is not true of the earlier one) ; the beginner does not want to read a long account explaining away some difficulty of which he is quite unaware, but on the other hand the same student will later find the book a very valuable commentary when he has got hold of the principles from other sources.

Of the two volumes, the first, of 280 pages, was developed almost entirely on the lines of the pure wave theory, and gave an admirable survey from that point of view. Its arrangement was a great improvement on that in some earlier books ; for example, such things as free motion and the passage of potential walls came before the structure of atoms. It traversed all the ordinary branches of the theory, and in the later parts gave a good account of a subject that can scarcely be called elementary, the so-called double quantisation. The new volume is a much more formidable affair, consisting as it does of more than 500 pages. Though it takes wave theory as its basis, it works mainly on the lines of operators and matrices, and it is perhaps not so good as the first, since it applies the same discursive method of detailed physical presentation, whereas in a second volume something more formal and deductive would have been appropriate. It takes one right back to the start in explaining the connexion of the method of operators and matrices with that of waves, whereas it would give a juster view of the relationship to present the operational method merely as a more powerful technique for dealing with matters of which the physical basis had already been expounded.

With this proviso, it will be found that the book gives a very full account of the essentials of the quantum theory. The progress is slow, and it perhaps makes unduly heavy weather of the mathematical technique, for, after all, no one who is not a fairly accomplished mathematician is competent to embark on such a detailed study of the quantum theory. It begins with classical theory and some discussion of waves and then in turn passes to operators, matrices, transformation theory, perturbations and the spinning electron. It then goes on to the problem of many particles, discusses in detail the difficult theory that is needed for such topics as ferromagnetism, and concludes with a review of the present unsatisfactory state of radiation theory. Altogether, anyone who is puzzled about any general point in the quantum theory will almost certainly find it explained somewhere, and indeed twice over, once in each volume, so that he can take it with whichever flavouring he prefers.

The two books illustrate a difficulty in the presentation of the quantum theory that will have to be gradually worked out ; and this is the question of what previous knowledge should reasonably be assumed in the student. For example, in Frenkel's first volume on p. 9 there stands unexplained the formula for the relativistic line element, whereas on p. 28 there is a rather detailed discussion of the ordinary group velocity of waves. There may of course be some difference in education in England and the U.S.S.R., but it seems a curious inversion of the order in which one would expect the student to learn mechanics. Sooner or later there will have to be an accepted body of fore-knowledge for the quantum theory, just as there is for such things as the theory of electricity. It is, of course, easiest to say that the student should know all about waves, all about electricity, all about relativity, all about the transformation theory of classical dynamics, all

about matrices and all about groups. Such a student would certainly be well equipped for his purpose, but it is to be doubted if he would still be a student by the time he was ready to begin. For the physicist, the main interest of some of these things is their bearing on the quantum theory, and so a knowledge of them should certainly not be assumed in advance.

There will be a fairly general agreement among authors about most of these subjects. Thus, though it must be admitted that algebra has been much neglected in the general mathematical courses in Great Britain, it would be out of place to assume any knowledge of matrices, and the same is true of group theory. On the other hand, it is natural to take for granted a considerable knowledge of waves, of classical electrical theory and optics, and some elementary knowledge of relativity. The most interesting question is how far the student should be taken in classical dynamics before beginning quantum theory; in particular, how much attention must be given to transformation theory. Ten years ago, everyone was deeply immersed in Poisson brackets, angle variables and such things, so that it was then natural to emphasise their analogies in the quantum mechanics. It is more questionable how far it is worth doing this now, for the new transformation theory is really simpler and far more important; and so it may not prove worth while to familiarise the student in advance with the classical transformation theory, since its chief interest is merely to show the analogy with something that ought itself to be still more familiar. These questions must be a matter of consideration to anyone making a presentation of the quantum theory, and no doubt with the lapse of time a fairly definite level of fore-knowledge will settle itself.

The reading of any book or paper on the quantum theory cannot but excite criticism of the slovenliness with which English equivalents have been chosen for certain foreign terms. There is not much harm in the actual use of a foreign word, at any rate until the associated idea has become entirely familiar; thus to borrow *austausch* unchanged does no harm, but only implies that the borrower was ignorant and too lazy to get a dictionary. It is when a purely German grammatical construction is literally translated that the result becomes intolerable. The adjective 'wave-mechanical' may perhaps just pass muster among those who are not very squeamish about their grammar, but such a horror as 'quantumtheoretical' (either as one or two words or hyphenated) really will not do. However much one may believe in exploiting to the full the flexibility of the language, this word surely strains it beyond the elastic limit, and, though we all dislike novelties, the proper way of finding the necessary contrast to the word 'classical' in English is to coin some such word as 'quantical'. These reflexions have been provoked by a general study of the literature and not specially by the present books. Prof. Frenkel has a very fine mastery of the English idiom, and has been well helped in his composition, so that it is only rarely that one comes across anything which even hints that he was not writing in his native language. C. G. D.

Modern Electromagnetic Theory

Electromagnetism. By Prof. Hector Munro Macdonald. Pp. xv+178. (London: G. Bell and Sons, Ltd., 1934.) 12*s*. 6*d*. net.

PROF. MACDONALD'S work apparently has grown out of his Adams prize essay on electric waves published more than thirty years ago and is certainly one of the most striking books on electromagnetic theory published within recent years. Its scheme is based on the laws of Ampère and Faraday together with Fresnel's law of transversality; and it leads to the result that "the electromagnetic field outside any closed surface, due to a distribution of matter inside, is determined completely when the components of the electric and magnetic forces tangential to the surface are known, but a knowledge of the external magnetic field is not sufficient to determine the electric and magnetic current distributions inside it". It follows that the external effect of the inside matter can be represented by electric and magnetic currents over the surface.

As in his essay on electric waves, so here, the author uses Maxwell's expression for the magnetic part of the electromagnetic energy in terms of the electric current and electrokinetic momentum instead of the more usual one in terms of the magnetic force and induction, and he deduces an expression for the flux of energy, which differs materially from the Poynting flux, being expressed in terms of the magnetic force and electrokinetic momentum. The author points out that both give the same total change in the amount of energy inside a surface in a time which is a multiple of all the periods involved, so that periodic disturbances cannot decide between the two views. It would be interesting if an expression could be deduced for the rate of radiation of energy from an electric charge moving with given velocity and acceleration for comparison with Liénard's well-known formula.

The book is divided into eight chapters, of which the first two are devoted to the general theory of propagation of electric effects in free space and material media, and the third and fourth to the transmission of waves in transparent and

conducting media. The fifth treats of electric currents in a conducting sphere with and without an external magnetic field, and the sixth, which is the longest in the book, gives a very full discussion of diffraction and scattering with special reference to the nature of the disturbance near the edge of the shadow and in the neighbourhood of caustics. The seventh and eighth deal with radiation and resonance and material systems in motion.

Quite apart from the frequently novel methods employed, the book is a very useful compendium of recent work on electromagnetism. It is well printed and produced and is commendably free from misprints, considering the often complicated character of the formulæ employed.

Tannin Chemistry

The Natural Organic Tannins: History, Chemistry, Distribution. By Dr. M. Nierenstein. Pp. vii + 319. (London: J. and A. Churchill, 1934.) 21*s*.

THE historical studies of Dr. Nierenstein, who is an authority on the history of the tannins, must be of interest to all workers on the chemistry of tannins and of leather. To read how closely Tachenius in 1677 foreshadowed recent work on the rotting of ink-dyed leather is a valuable reminder of the length of time which elapses between suggestion and proof in this branch of chemistry.

In dealing with the organic chemistry of the tannins, Dr. Nierenstein gives a useful description of existing knowledge, somewhat obscured by a detailed account of the controversies between the rival schools of Nierenstein and of Fischer and Freudenberg. It is doubtful whether the differences at issue in the catechin group are of sufficient importance to require detailed description in a general treatise. The discussion of the constitution of the gallotannins, however, makes it clear that some of the conclusions of the German school must be regarded with doubt, yet, as Dr. Nierenstein himself points out, his suggested formula for glucosidic gallotannin is not far removed from formulæ which Freudenberg admits as possibilities. It is not easy to reject the larger volume of evidence that glucose is an essential part of the gallotannin molecule on the grounds of the few reported observations of the occurrence of the tannin free from glucose. References to "the glucose spectre, haunting the chemistry . . . of gallotannin" and to the glucoside hypothesis as a "stumbling block" are unduly strongly worded.

From the practical point of view of the tanner, the significant difference between the two classes of tannins is that the pyrogallol tans contain more ionisable hydrogen atoms and therefore have a more acid reaction than the catechol tans. Variations between the action of different tans of the same class are to a large extent due to differences in the size of the tannin particles in solution. The physical chemistry of the tannins requires as much attention as has been devoted to their organic chemistry. Perhaps in future editions Dr. Nierenstein, and other writers on the chemistry of the tannins, will give some account of information which is already available on this aspect of the subject.

The botanical section, written by Dr. MacGregor Skene, collects the existing knowledge of the distribution, behaviour and functions of tannin in the plant. This useful summary contains some interesting suggestions. If the catechol tannins are related to the anthocyanins, and play a part in metabolism, while the gallotannins are excretory products, it is an attractive speculation that the initial by-products of metabolism are rendered harmless by combination with glucose. Perhaps 'glucose siren' would be a more appropriate expression than 'glucose spectre'. The charmer is too seductive to be dismissed lightly, and the time has not yet come when we must stop our ears, in spite of the Ulyssean warnings of Dr. Nierenstein. D. JORDAN LLOYD.

Evolution of Ideas of Space

The Differential Invariants of Generalised Spaces. By Prof. Tracy Yerkes Thomas. Pp. x+241. (Cambridge: At the University Press, 1934.) 21*s*. net.

THE subject of this book is extremely difficult for the general scientific reader. Even what seem to be familiar words, such as *space* and *parallel*, are used in such generalised senses that they become more puzzling than entirely new terms. This is the result of a process of evolution, and can be understood only by recalling the history of these ideas.

For the Greeks, the rigid body was fundamental, and space was mere emptiness containing it. Geometry expressed the properties of rigid bodies such as measuring rods, including the properties of congruence, established by superposition. Thus geometry was primarily a physical science, but it was reduced to a deductive form, based on a small number of axioms which, with the exception of that relating to parallels, could plausibly be regarded as self-evident truths. The idea of space as consisting of points was reached

about two thousand years later, from the analytical geometry of Descartes (1637). In Newton's laws of motion (1686) space was considered a physical reality. Henceforth the term really bore two different meanings, one mathematical and one physical, but the distinction did not become clear until the great mathematical and physical advances of the nineteenth century. *Ether* (according to Einstein) is merely the name given by Faraday and Maxwell to space regarded as the seat of electromagnetic phenomena. On the mathematical side, the long-continued efforts to prove Euclid's parallel-axiom led to the discovery by Lobachevski (1829) and Riemann (1854) that perfectly logical systems of geometry could be devised in which the parallel-axiom was denied. The term non-Euclidean was introduced by Gauss. Space and geometry were no longer unique, for they could be based on any self-consistent set of postulates. However, this aspect did not receive much attention until the work of Pasch, Peano, Hilbert and others, at about the beginning of the present century.

When it was realised that the co-ordinates of Descartes were not restricted to Euclidean space, there remained no reason for restricting the number of dimensions to three. Cayley (1843) and Grassmann (1844) dealt with analytical geometry of N dimensions. In 1859 Cayley put forward his theory of the *absolute*, which was later developed by Klein, whose Erlangen programme (1872) had a far-reaching effect. Klein considered certain groups of transformations by which a set of points are permuted among themselves. To every such group corresponds a particular kind of geometry. For example, to the *affine* group (the group of all linear transformations) corresponds affine geometry, including the plane geometry defined by such of Euclid's axioms as do not refer to congruence. But wide as was Klein's scheme, it still required extension. So early as 1854, Riemann, in his famous dissertation "Hypotheses which lie at the Foundation of Geometry", had given a geometry of quite a different kind, in which the idea of length was fundamental. In this, the group concept failed. Contemporary geometers are now generalising the Erlangen programme, starting with the invariant which always exists, rather than the group from which the invariant may or may not have arisen. The idea of an invariant goes at least as far back as Gauss (1827), who considered the general problem of measurements on curved surfaces and obtained an expression for the curvature valid in any system of co-ordinates. This was the first example of a differential invariant. Further developments were due to Riemann (1861) and Christoffel (1869). The theory of tensors, so important in physics and geometry on account of their property of vanishing in every co-ordinate system if they vanish in one, was created by Ricci (1887) and his pupil Levi-Civita, although the name *tensor* was not introduced by them, but by Einstein (1916). Levi-Civita's concept of infinitesimal parallel displacements (1917) is of great importance, though his use of the word parallel is liable to be misunderstood. Weyl (1918) has contributed to both the mathematical and physical theories, which now, after a long separation, have come together again.

To many, the mathematical ideas of space seem important only as a quarry from which Einstein can obtain the stones to construct his physical theories. However, even from this narrow point of view, the quarrymen should be encouraged to extend their operations, since we do not yet know what kinds of stone will be most useful. The slow progress of the unified field theory seems to show that the present materials are not altogether suitable. The wider point of view is that the study of differential invariants is now pursued for its own sake, and the workers who are cultivating this field must not be hampered by the demand that they should look back and see how closely they are being followed. What started as geometry and developed as mathematical physics now exists in an abstract form independent of either, like the grin of Lewis Carroll's Cheshire cat when the cat itself had vanished.

Prof. Thomas gives an account of this abstract theory which is exclusively analytical, taking the invariant as fundamental, and pushing the geometrical or physical interpretation into the background. The earlier chapters deal with generalised spaces, invariants (including non-tensor invariants), and normal co-ordinates. Then there is a very full treatment of spatial identities, of which the best-known example expresses the conservation of energy in a gravitational field. This is followed by important chapters on equivalence and reducibility. The book concludes with a chapter on functional arbitrariness, and a rather meagre index. There are bibliographies at the end of each chapter.

The research worker who needs an account of the latest advances (many due to Prof. Thomas himself) will find the book of great value. On the other hand, the ordinary student may find it difficult. Those to whom the subject is new should start with two Cambridge 'Tracts', Veblen's "Invariants of Quadratic Differential Forms" and Veblen and Whitehead's "Foundations of Differential Geometry", which explain the elementary ideas indispensable to an appreciation of the highly sophisticated modern developments.

H. T. H. PIAGGIO.

Short Notices

Anthropology and Ethnology

Habitat, Economy and Society : a Geographical Introduction to Ethnology. By Prof. C. Daryll Forde. Pp. xiv+500. (London : Methuen and Co., Ltd., 1934.) 15*s*. net.

ALTHOUGH the traditional evolutionary view of human society as a progression, which begins with food-gathering and ends with industrialism, does not now commonly occur in geographical and other textbooks in all its cruder simplicity, the various forms of human society are still often treated as if they could be classified in mutually exclusive types, each characterised by a single activity. Prof. Daryll Forde, by describing the life-histories and activities of peoples of primitive culture who, at least up to a few years ago, were untouched by Western civilisation, indicates the misleading trend of this conception. He demonstrates by concrete example the inherent complexity in even the most simple of societies, and the degree to which it is possible to maintain the traditional division of hunters, pastoralists, cultivators and the like.

The claims of description and classification in Prof. Forde's book, however, do not account for the whole of his story ; and it is in its broader aspects as an analysis of the development of culture that its greatest interest is to be found. In recognising the effect of, and assigning their appropriate function to environment, diffusion and economic and social factors, as a causation complex in the growth of culture, the author has made a valuable and substantive contribution to method and theory in anthropological studies.

Rebel Destiny : Among the Bush Negroes of Dutch Guiana. By Melville J. Herskovits and Frances S. Herskovits. (Whittlesey House Publication.) Pp. xvii+366+15 plates. (New York and London : McGraw-Hill Book Co., Inc., 1934.) 12*s*. 6*d*. net.

DR. HERSKOVITS, as students of current anthropological literature are aware, has been engaged for some time in studying the cultural status of the African Negro, with special reference to what is sometimes known in America as the Negro problem. With this objective he has worked in West Africa ; and has made a valuable study of the American Negro and the results of Negro crossing in the United States. In the course of his investigations, he has visited the communities of the Bush Negroes on the Suriname River in Dutch Guiana, which were formed after the rebellion of Negro slaves some hundred and fifty years ago. The members of these communities recreated something of their native African culture and this they have preserved in a modified but characteristic form ever since.

In the volume under notice, Dr. and Mrs. Herskovits give a popular and lively account of their contacts with these Bush Negroes. It is valuable as giving an insight into the mentality of a little-known people, and affords material for a comparison with the mentality and beliefs of the Negroes of the West Indies and the less advanced descendants of Negro slaves in the United States. The more strictly scientific account of the authors' results is to be published later.

Proceedings of the First International Congress of Prehistoric and Protohistoric Sciences, London, August 1–6, 1932. Pp. iv+322. (London : Oxford University Press, 1934.) 21*s*. net.

As it is unlikely that anyone seriously interested in the work of the First International Congress of Prehistoric and Protohistoric Sciences is unacquainted with the scope of its programme, it is unnecessary to do more here than note the appearance of the volume recording its proceedings. In addition to lists of officers, council and committees, the official report of the programme followed and other administrative and historical detail, it gives abstracts of the papers, which not only serve as a record of the communications submitted, but are also sufficiently full, so that, although not complete, each will serve as a locus of reference.

Biology

The Dinosaurs : a Short History of a Great Group of Extinct Reptiles. By Dr. W. E. Swinton. Pp. xii+233+25 plates. (London : Thomas Murby and Co., 1934.) 15*s*. net.

OF all extinct animals, the land reptiles named Dinosaurs are the most widely familiar and most frequently mentioned. The gigantic and bizarre proportions of many of them appeal to the popular imagination, and they often lend themselves to effective use in humorous pictures. Dr. Swinton has therefore done good service by writing and publishing an authentic account of our present knowledge of these animals, to which easy reference can be made. He has treated the subject from every point of view, and the attractiveness of his book is much enhanced by several beautiful photographs of new restorations of Dinosaurs made under his direction by Mr. Vernon Edwards.

After some preliminary chapters, in which there are interesting hypothetical maps of the world during the three long periods when Dinosaurs flourished, the various groups are described and discussed in systematic order. The account is remarkably exhaustive and well up to date. For the naturalist, it furnishes an admirable compendium which cannot be found elsewhere ; for the general reader it will prove more difficult on account of the frequent use of technical terms and expressions, although some of these are explained in the glossary at the end.

In one of the final chapters, Dr. Swinton remarks on the rarity of traces of disease in the bones of Dinosaurs ; and in another chapter he discusses the possible causes of the complete extinction of the

group at the end of the Cretaceous period, without reaching any more definite conclusion than previous observers have done. He has also some interesting notes on the methods of collecting and preparing Dinosaurian fossils, and he concludes with a useful alphabetical list of those which have been found in Britain. Lists of the literature of the subject throughout the book make it a valuable work of reference for those engaged in research. A. S. W.

The Great Design: Order and Progress in Nature. Edited by Frances Mason. Pp. 324. (London: Gerald Duckworth and Co., Ltd., 1934.) 8*s.* 6*d.* net.

THE aim of this work is to show the plain man that the world, as we know it, is shot through and through by pattern and law, and that this implies the existence of a supreme designer and law-maker, the basis of religious faith. Its method is to bring together a series of essays, each written by an expert, in which departments of science are discussed from a modern point of view in order to bring out the prevalence of order and its implications.

The result is less satisfactory as a unified body of opinion than the editor's earlier "Creation by Evolution": there is a good deal of overlapping, for example, in the repetition of the story of radiation, protons, electrons, and so on; and there are frequent contradictions, as when the geologist takes the continents and ocean basins to be, on the whole, permanent features, while the zoologist assumes the occurrence of continental drift to explain the migrations of eels and of birds, or when the zoologist postulates for the origin of life an act of creation, while the botanist states that protoplasm was originally evolved from non-living matter. Moreover, the compression of some of the essays makes the conclusions seem far removed from the facts on which they are based, so that they must appear to a non-scientific reader as little more than a series of dogmas.

The book, however, gives simple summaries of the position of science in many fields, and the reader cannot but be impressed by the number of scientific workers who find, each in his own field, that the discoveries of science afford a rational basis on which faith may rely. There is no necessary contradiction between science and religion. J. R.

Bumblebees and their Ways. By Prof. Otto Emil Plath. Pp. xvi+201+11 plates. (New York: The Macmillan Co., 1934.) 17*s.* net.

THIS book is based upon first-hand observations carried out during thirteen consecutive seasons on the bumble bees known to inhabit New England and other parts of North America. The author is evidently an ardent and skilled field observer, and has produced a very readable and interesting natural history study. Bumble bees have not hitherto received very much attention from the biological point of view in America, although an excellent taxonomic guide is available in Franklin's "Bombidae of the New World". Dr. Plath has already written a number of papers on bumble bees in various North American periodicals and, while the substance of this work has been incorporated in the pr sent volume, the greater part of its contents consists, he tells us, of material not hitherto published.

The book is divided into thirteen chapters dealing with different phases in the life of these insects. The author has been very successful in adopting means of rearing bumble bees in artificial nests, and describes his methods. By this means, in conjunction with his field work, he has been able to add to what is known concerning their habits. Among the new results of his studies, mention needs to be made of the evident 'behaviouristic' differences that he brings to light among different species. These observations form the basis of his classification of the species into groups—a feature which has been a long-standing difficulty.

At the end of the book there is a useful synopsis of the common American Bombidæ, with their distribution and habits, followed by an adequate bibliography. We note that the names *Bremus* and Bremidæ are withdrawn by Dr. Platz, and trust that there will not be occasion for their revival.

A. D. I.

An Introduction to the Vertebrates. By Prof. Leverett Allen Adams. Pp. v+414. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 21*s.* 6*d.* net.

THIS is a useful and, for its bulk and within the limits the author set himself, a very comprehensive work. A slight formal description of the classificatory characters of the vertebrate groups and subdivisions is followed by more detailed discussion of the organic systems of each class, based for the most part upon selected types. The third and most important section of the book contains comparative accounts of the various anatomical systems and of specialised structures. Descriptions are concise and to the point, illustrations are abundant and clear, and the schematic diagrams, for example, of the blood circulation, give an easily grasped picture of progressive changes. Our one complaint, a minor one, is that in the pictures which illustrate the preliminary classification, no indication of reduction is given, so that a meadow-lark looks as large as its neighbour, a penguin, and a *Tarsius* larger than a hippopotamus. J. R.

Economic Mammalogy. By Junius Henderson and Elberta L. Craig. Pp. x+397. (London: Baillière, Tindall and Cox, 1932.) 26*s.*

MANY readers outside the ranks of zoologists will study this book with interest and profit, for in easy style it discourses upon almost every conceivable way in which mammals come in contact with mankind for good or ill. Its speciality, apart from the interest of its classification of mammalian economics, is statistics, and the figures, whether of meat consumption, of the slaughter of fur-bearing animals, of damage done to crops and stocks, and so on, are up-to-date and astounding. The general discussion

is followed by a résumé of the economic interests of each mammalian order and, in the case of the more important orders, of their families. It is only fair to add that the authors have almost entirely ignored literature published beyond America, but the field is enormous, and they have done their part well. J. R.

Life in the Making. By A. F. Guttmacher. Pp. 288. (London: Jarrolds Publishers (London) Ltd., 1934.) 10*s.* 6*d.* net.

MR. GUTTMACHER gives a statement in non-technical language of the present state of knowledge of the physiology and genetics of reproduction, with special reference to man. The origin of the life of the individual in the fusion of the sperm and the egg, the rôle of sex hormones, the determination of sex, factors affecting fertility and the cause and characteristics of like and unlike twins are treated in a scientific setting, but with an absence of technical terms unknown to the ordinary educated reader. In each section of the subject, the growth of knowledge is traced from the earliest known myths and superstitions to the present day. The book is eminently suitable for the reader who wishes to get a general scientific knowledge of reproductive phenomena in man.

Chemistry

Organic Chemistry: or Chemistry of the Carbon Compounds. By Victor von Richter. Edited by Prof. Richard Anschütz and Dr. Fritz Reindel. Vol. 1: *Chemistry of the Aliphatic Series.* Newly translated and revised from the 12th German edition (after the translation of the 2nd English edition by Dr. Percy E. Spielmann) by Eric Newmarch Allott. Pp. xiv+790. (London: Kegan Paul and Co., Ltd.; Philadelphia: P. Blakiston's Son and Co., 1934.) 35*s.* net.

RICHTER's manual has been available in English over a long period of years, and the need for successive editions is a sufficient indication of the esteem in which it is held by students and teachers. A valuable feature of the latest edition is the replacement of references to the *Centralblatt* by those to the originals from 1910 onwards, some additional references being included. The character of the book is too well known to require explanation. It is essentially a descriptive account of compounds, the theory being kept to a minimum. The brief statements of preparations and properties, with numerical data, make it a valuable work of reference, but the large amount of ground covered makes it hard reading for students.

The printing is excellent, the structural formulæ being very clearly set out, and as an account of the general chemistry of aliphatic compounds in a reasonable space the book is without rival. It should be found in every chemical library; and everyone interested in organic chemistry, even incidentally, will find it useful. The literature appears to have been well covered up to quite recent papers, and the amount of information given is impressive.

The Fundamentals of Chemical Thermodynamics. By Dr. J. A. V. Butler. Part 2: *Thermodynamical Functions and their Applications.* Pp. x+271. (London: Macmillan and Co., Ltd., 1934.) 8*s.* 6*d.*

DR. BUTLER's second volume gives a simple and readable account of the more modern aspects of thermodynamics on the lines of the activity concept. Experimental data are given, with clearly drawn curves, to illustrate the applications of the methods, and there are some problems and exercises. In some parts, the treatment seems too restricted and liable to create a false impression; for example, only a few lines are given to the extensions of the theory of Debye and Hückel by La Mer, Gronwall and Sandved, whilst it is well known that the simple theory fails in nearly all cases which have been adequately examined; Fig. 12, whilst showing "excellent agreement", as the author says, is superseded by more modern work which is not mentioned. Although the book cannot be said to provide an adequate critical discussion of the modern aspects of experimental thermodynamics, it deals in an able manner with the theory, and may be recommended to students as an introduction to more detailed treatises.

Physico-Chemical Practical Exercises. By Prof. William Norman Rae and Prof. Joseph Reilly. Pp. xiv+276. (London: Methuen and Co., Ltd., 1934.) 7*s.* 6*d.* net.

THE authors, whose massive treatise on physicochemical methods is, or should be, part of the furniture of every well-equipped laboratory, have now provided a handy and inexpensive volume in which is described, succinctly and clearly, a series of standard exercises ranging from density determinations to measurements of ionic mobilities, electrolytic conductivities and hydrogen ion concentrations.

They give useful advice on methods of calculation and standardisation; something is said concerning nomograms, and we are glad to see that the long story of the calibration of a mercury-in-glass thermometer is omitted in favour of the more practical process of direct comparison with a thermometer possessing an N.P.L. certificate. A. F.

Geology

On the Mineralogy of Sedimentary Rocks: a Series of Essays and a Bibliography. By Prof. P. G. H. Boswell. Pp. ix+393. (London: Thomas Murby and Co., 1933.) 21*s.* net.

PROF. BOSWELL is well known as a leading authority on sedimentary petrology, a subject which has developed vigorously during the last two decades, largely as a result of his own researches. In this book, he summarises the literature and presents his own mature views on various aspects of sediments and their minerals, thereby making readily available to everyone interested in this branch of geology an authoritative and stimulating account of the present status of the subject and its significance.

More than half the book consists of a bibliography of 1,025 items, each accompanied by a brief but adequate abstract. The essays deal with such topics

as the history of investigation, detrital minerals, their assemblages, stability and application to problems of provenance and correlation, authigenic minerals, clay minerals and various individual types of sediment.

A very complete series of indexes adds greatly to the usefulness of the book. These make it easy to find every available reference to stratigraphical horizons, localities, minerals, figured minerals and technique. To students, the book is an unrivalled introduction to the subject; while to research workers in this field it is an indispensable aid to further progress.

The Determination of the Felspars in Thin Sections. By Dr. Karl Chudoba. Translated by Dr. W. Q. Kennedy. Pp. xii+62. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1933.) Cloth, 6*s*. 6*d*. net; paper, 4*s*. 6*d*. net.

THE felspars constitute by far the most abundant group of the rock-forming minerals, and their importance in petrographic description and classification is correspondingly high. A translation of Dr. Chudoba's little handbook on the determination of the felspars in thin sections of rocks is therefore particularly welcome. The problems involved are often difficult, but the author has succeeded in giving simple and accurate descriptions of methods which adequately meet most of the practical requirements. The diagrams and photomicrographs, numbering fifty in all, are clear and effective and embody useful summaries of the diagnostic optical properties. The translation has been very successfully carried out and will be highly appreciated by students and practising petrologists.

Mathematics

Elementary Calculus. By C. V. Durell and A. Robson. Vol. 1. Pp. viii+240. 4*s*. 6*d*. Vol. 2. Pp. xii+241–548. (London: G. Bell and Sons, Ltd., 1934.) With appendix, 7*s*. 6*d*.; without appendix, 6*s*. 6*d*.

THE authors of these volumes are among the teachers who are convinced that the youngest student of mathematics should be taught nothing which he will have to unlearn, and that unsound principles are not in fact easier to inculcate than sound ones. The references to Marlborough and Winchester in scholarship and tripos lists show that this theory of mathematical education works well in practice.

The first volume is strictly elementary both in range and in method: the only functions involved are rational and circular, about half the volume consists of unworked examples, and a considerable proportion of the exposition is conducted by means of worked examples. Perhaps the most interesting feature is the early introduction of differentials. The infinitesimal increments familiar in the nineteenth century were so dangerous that the differentials which were confused with them shared their banishment first from the university and then from the school. The true differential returned to Cambridge just after the War, and the current movement to welcome it back to more elementary class-rooms gains strong support from Mr. Durell and Mr. Robson.

The second volume is a continuation of the first. The structure is extended, on the foundations already laid. These foundations are sound, and of the multitude of students to whom familiarity with the processes of the calculus is a necessity, only a few need undertake a critical examination of them. Examples, worked and unworked, play the same part as in the first volume. The range includes the standard integrations, the commonest geometrical applications of the calculus, and an introduction to ordinary differential equations; the heading of approximations covers not only a statement of Taylor's theorem, but also an account of multiple points and asymptotes of plane curves which in spite of tradition certainly does not belong to a course on the calculus.

If a detail here or there invites criticism, this is not the place for it. The "Higher Certificate" ground has seldom been covered so admirably as in this careful and inspiring work, which fully maintains the authors' reputation. E. H. N.

Analytical Geometry. By Prof. V. Poor. Pp. v+244. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 13*s*. 6*d*. net.

DR. POOR's treatment of analytical geometry is based upon the vector method. It embraces the conic sections in both two and three dimensions, and also some valuable matter on higher plane curves and curve fitting.

The theory connected with the ellipse and hyperbola is considerably shortened and elegantly dealt with generally by the introduction of λ for $a^2(1-e^2)$. Diameters, poles and polars are considered in a separate chapter, so that they may be omitted, if necessary, without loss of continuity.

The last four chapters are devoted to a concise discussion of solid analytical geometry, and an excellent plate is provided clearly illustrating the ellipsoid, the elliptic paraboloid and the hyperboloids. Adequate exercises are supplied which are not only well graded but are also designed to illustrate clearly the principles established in the text.

Miscellany

Faraday. By Thomas Martin. (Great Lives Series, No. 40.) Pp. 144. (London: Gerald Duckworth and Co., Ltd., 1934.) 2*s*. net.

THERE exists, nowadays, no lack of examples for those who would practise the difficult art of biography. At one end of the scale appears Hill's "Boswell", edited anew in six magnificent volumes, and still remaining, despite the new knowledge which has accrued to our generation, an enduring monument to Hill's genius as an editor. At the other end we have these florin biographies, wherein he who desires to discourse learnedly may gain his knowledge at the expense of an hour's reading. But, to invert a well-known *obiter dictum*, easy reading means condemned hard writing, and that author has his work cut out who would compress into a hundred and forty small octavo pages, a critical biography which shall tell

something of the man, something of his work, and shall descend to those pedestrian but necessary details of fact and date which your tendentious or psychological biographer is disposed to ignore.

A newly appointed provincial mayor once announced to his fellow-magistrates that it would be his constant endeavour to tread the narrow path which lies between right and wrong. Mr. Martin has had a different, but equally difficult path to tread, and he has succeeded where some of his predecessors must be held to have failed. He has limned for us a pleasant picture of Faraday's charming and simple personality; he has not been afraid to give us relevant dates and facts; and he has provided for that difficult fellow, the intelligent layman, apt to become confused between magneto-electrics and electro-magnetics, a statement of Faraday's contributions to science which is intelligible, interesting and accurate. What better investment can a cautious reader demand for his florin? A. F.

Empire Social Hygiene Year-Book 1934. Prepared by the British Social Hygiene Council, Inc. First Annual Edition. Pp. 509. (London: George Allen and Unwin, Ltd., 1934.) 15*s*. net.

THIS year-book constitutes the first comprehensive survey that has been made of the subject of social hygiene. The book has been largely compiled from material made available by various Government departments and health authorities concerned, and contains recent information on the incidence of venereal diseases and facilities for their treatment in towns and counties at home and throughout the Empire. Certain vital statistics, such as the death rate, infant mortality rate, death rate from tuberculosis, and number of mental defectives, together with some details of biological teaching in schools, for each area dealt with are also included. It is proposed that one Dominion, or group of Colonies, should be the subject of a special survey in each annual issue, and Canada is selected for this volume. Special articles and appendices conclude this useful Empire Year-Book.

Greek Geography. By E. H. Warmington. (The Library of Greek Thought.) Pp. xlviii+269. (London and Toronto: J. M. Dent and Sons, Ltd., 1934.) 5*s*. net.

As no early treatise on Greek geography has survived, the materials for re-constructing Greek notions of this subject have to be extracted from historical writers, or from later compendia of Roman date, such as Strabo and Pliny. This Mr. Warmington has done, giving English translations throughout, and grouping the passages under the main heads of cosmology, climatology, physical and political geography, exploration and mathematical geography with cartography. It was a pity to exclude writers so important as Xenophon and (in the main) Aristotle, though the difficulties of treatment are obvious. Necessary commentary is interpolated among the excerpts, or added in footnotes. There is a serviceable introduction and a good index.

The Book of Air and Water Wonders. By Ellison Hawks. Pp. 272+31 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1933.) 7*s*. 6*d*. net.

MR. HAWKS, the editor of the *Meccano Magazine*, has so many popular books on ships, machinery, astronomy and Nature, that we have lost count of them. They are most readable books, full of interesting sidelights and well illustrated. His latest book on the atmosphere, dew, fog, clouds, rain, wind, rivers, waterfalls and lakes, like his others, contains a lot of beautiful photographs, and from the armchair we are carried pleasantly to see Nature at work in many parts of the world.

Philosophy

Science and Sanity: an Introduction to Non-Aristotelian Systems and General Semantics. By Alfred Korzybski. (International Non-Aristotelian Library.) Pp. xx+798. (Lancaster, Pa.: The Science Press Printing Co., 1933.) 5.50 dollars.

BY analogy with a series of mathematical theories constructed on the negation of this or that axiom, Mr. Korzybski attempts to build up a non-Aristotelian system of universal knowledge. "Non-Aristotelian" is the name given to the system, because it purports to require the rejection of the famous principle of identity. This very foundation of the non-Aristotelian system seems very insecure to the present reviewer, for two reasons: in the first place, no one has consciously affirmed the principle of identity in the sense that Mr. Korzybski denies it; and secondly, this very principle is continuously, though covertly, used by the author, not only in the exposition of his views but also as identity of structure. The avalanche of irrelevant quotations from all fields of human knowledge does nothing but to add to the confusion in which one is left after reading this bulky volume. T. G.

The Horizons of Thought: a Study in the Dualities of Thinking. By Prof. G. P. Conger. Pp. xi+367. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1933.) 22*s*. 6*d*. net.

PROF. CONGER has a peculiar method of expounding his philosophy. He amasses a wealth of quotations or paraphrases which are, at least verbally, relevant to his subject, without taking the trouble to discuss them in their actual context, and he goes on to draw some general and obvious conclusions which leave the reader none the wiser. His main thesis is that "our thinking proceeds by selection and at the same time a correlative neglect", the horizons of our thought have always a beyond, the spotlight leaves a background unilluminated. The author applies this thesis to widely diverse realms, from mathematics to ethics, and deduces more or less relevant conclusions. The reviewer cannot help thinking that Prof. Conger seems to leave in the background most of the problems which he wishes to solve: the spotlight of his analysis ought to go beyond the actual horizon of his thought as expressed in this volume.

Physics

Air Ministry: Meteorological Office. Professional Notes, No. 66: *Lightning and Aircraft*. By G. C. Simpson. Pp. 24. (London: H.M. Stationery Office, 1934.) 4*d*. net.

It is fortunate for aviation that Dr. Simpson should have first become prominent largely through the study of the electricity of thunderstorms, and in virtue of that fact and of his official position as director of the Meteorological Office, it would be expected that a handbook dealing with the risks of damage to aircraft due to lightning would not only be as helpful in that direction as the present state of knowledge allows, but would also be a boon to those seeking to learn something about atmospheric electricity without having to embark upon an elaborate treatise such, for example, as that of Elster and Geitel. This expectation is fully satisfied, for in only twenty-four pages both needs are met. The work of condensation has been so well done that on the theoretical side the average intelligent scientific reader who is not a specialist in atmospheric electricity is not likely to realise the amount of condensation that has been effected. This is a subject in which it is only too easy to find oneself unable to see the wood for the trees, the more so as the trees are often enveloped in a fog of controversy, and after experts have met to discuss its unsolved problems there is apt to be an intellectual battle, and a casual spectator may not be able to distinguish victor from vanquished.

On the meteorological side, a fairly definite picture emerges of the broad facts connected with the separation of the opposite electricities under various types of weather, the impression at the same time being conveyed that much remains to be learned about the mechanisms involved. On the practical side, one gathers that an aviator should not be unduly alarmed at the prospect of his machine being struck by lightning, especially if it embodies a sufficient amount of metal so arranged as to make the whole machine an electrical conductor of low resistance, unless the machine has a trailing aerial leading into the cockpit. When violent atmospherics are encountered, and cumulo-nimbus clouds are seen ahead, a trailing aerial must be hauled in with the utmost dispatch, if the lives of the occupants of the machine are not to be endangered.

Applied Geophysics in the Search for Minerals. By Prof. A. S. Eve and Prof. D. A. Keys. Second edition. Pp. xi+296. (Cambridge: At the University Press, 1933.) 16*s*. net.

In this new edition of their excellent introductory textbook to the rapidly developing science of geophysical prospecting, the authors have kept to the lines of the original work of 1929. Although a brief review of modern developments since that year has been added to each chapter, the book remains restricted to a manual intended rather for the use of non-geophysical mining engineers, geologists and others who have an economic interest in prospecting, than for physicists and theoretical students of geophysics.

Within these limitations, the revisions made by the authors suffice to bring their work up to date, with a few exceptions. The opportunity might have been taken to revise the rather meagre and somewhat inaccurate descriptions of certain instruments which have been developed outside the United States, and for which full descriptions have long been available. For example, the diagrammatic picture of the gravity gradiometer, Fig. 91, still perpetuates the error of representing the radial dimensions as 20 cm., instead of its correct value 4·5 cm., whilst Evershed's 'earth'-tester is still referred to as a "Megger".

In a book of this type one has no right to expect detailed descriptions of instruments, in all their variety, but one does expect the details given to be accurate in the essential features, and one would prefer the illustrations to refer either to the original models which have a historical value, or to the latest models which replace the obsolete types.

Some of the earlier descriptions of special methods, notably in the electrical chapter, might well have been replaced by more detailed accounts of the modern methods of potential ratio, resistivity and inductive geoelectrical prospecting.

Engineering Radiography. By V. E. Pullin. Pp. vii+136. (London: G. Bell and Sons, Ltd., 1934.) 45*s*. net.

The use of radiographic methods for the examination of welds and castings and for the detection of cavities, cracks and other flaws is rapidly increasing and there must be a considerable demand for an authoritative book dealing with the results so obtained. No one is better qualified than Mr. Pullin to write such an account and he has produced one which is full of interest and essentially practical. He has little to say as regards X-ray plant, a subject adequately treated elsewhere, but has confined himself to such questions as the preparation of the specimen and the interpretation of the radiographs. The book is very fully illustrated with photographs covering a range from simple welds to complicated castings, and alongside the radiographs are given illustrations of the actual flaws revealed by cutting up the specimens. In this way Mr. Pullin effectively demonstrates not only the potentialities but also the limitations of the method.

Of particular interest is the section dealing with γ-ray radiography. While γ-rays require longer exposures and give radiographs with poorer contrast, they possess certain advantages. It is found that X-rays are in general to be preferred when the thickness of the specimen does not exceed the equivalent of 3 in. of steel, while γ-rays give better results with more massive specimens and irregularly shaped castings. On account of its smaller bulk, the γ-ray apparatus can often be used when it is impossible to mount the X-ray tube in a suitable position.

Both the author and the publishers are to be congratulated on the excellence of the illustrations and the general lay-out.

Television for the Amateur Constructor. By H. J. Barton Chapple. Second edition. Pp. xxiii+266+54 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1934.) 12*s.* 6*d.* net.

THE notable part played by amateurs in the early days of long-distance radio communication is mentioned in every history of the subject. In the hope that they will give similar help in the development of television, the author has written this book for amateurs. The transmission of vision by radio is now an accomplished fact. When developed further, it will provide the 'something new' which will prove a welcome tonic to several of the entertainment industries.

Although the developments that have taken place in the art during the last eight years have been marvellous, it has to be remembered that the ear will tolerate a good deal more than the eye. Although early loud-speakers gave travesties of music and speech, they were listened to by many with enjoyment. But as J. L. Baird says in his foreword, no amount of 'looking-in' at a television image will make a twisted line appear straight. The book can be recommended to those who want to make a start in experimenting on television.

Electrical Communication. By Prof. A. L. Albert. Pp. ix+448. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 31*s.* net.

THIS treatise gives a fairly complete account of electrical communication over long distances. We think that perhaps a little more space might have been devoted to explaining the elements of radio communication, but the subject is now so extensive that it is difficult to discuss all branches of it in one book.

After giving the history of the development of electrical communication, and chapters on sound, speech and hearing and the theoretical basis of telephony, a description is given of transmitters, receivers and loud-speakers. Telephone transmission theory is essentially mathematical, but much of what has been given will be intelligible to the ordinary engineer. The author recognises that most engineers in the communication industry are engaged in work which is not technical. Only a few are working at problems like filter design and improving transmission systems. He points out that submarine telephone cables are subject to interference by electrical and magnetic storms like the aurora borealis. At certain times these natural disturbances may render submarine telephone cables inoperative.

A Guide to Electricity: for Home and School. By Dr. Charles F. Smith. Pp. ix+73. (London: Oxford University Press, 1934.) 2*s.* 6*d.* net.

THIS book is an attempt to explain in simple terms the main principles underlying the supply and utilisation of electrical energy, so far as these are of practical importance in the ordinary household. We think the author has been very successful. The definitions given are scientifically accurate, and the explanations given are novel and lucid. We liked the chapter on "Home Practical Work". It is shown how anyone, although he has no previous experience or mechanical aptitude, can carry out interesting and instructive experiments on an ordinary table without any equipment beyond a few electrical fittings, which can be purchased very cheaply, and the use of the domestic electric supply.

The Thermodynamics of Electrical Phenomena in Metals. By P. W. Bridgman. Pp. vii+200. (New York: The Macmillan Co., 1934.) 16*s.* net.

DOES any need exist to do more than tell the reader that Prof. Bridgman discusses, in this compact volume, thermo-electric phenomena, the thermodynamic analysis of the Volta effect, thermionic phenomena, the effect of surface charge on vapour pressure and electron emission, thermo-electric phenomena in crystals, transverse phenomena, and connexions with the electron theory of metals and photo-electric phenomena? Whatever he discusses, new or old, recondite or obvious, Prof. Bridgman can be trusted to invest with an added interest, for the matter under review has passed through the crucible of a vigorous and inquiring mind.

The volume may be heartily commended.

A. F.

Technology

The Manufacture of Gas. Edited by H. Hollings. In three volumes. Vol. 1: *Water Gas.* By Dr. R. H. Griffith. With a Section on Temperature Measurement, by H. C. Exell. Pp. xv+260. (London: Ernest Benn, Ltd., 1934.) 36*s.* net.

ONE of the welcome signs of the industrial revival in England is the increasing number of first-class technical books "made in England" replacing the former translations. This manual on water gas is an example of this trend: the author has practical knowledge of his subject and he has been permitted to use freely the information available at the works of the Gas Light and Coke Company, where there are several plants containing the latest modifications of design. Water gas to-day is required on the largest scale at a very low cost, so that there has been considerable urge to perfect the processes of its manufacture. Its use in the gas industry has been supplemented by other uses and may shortly be exceeded, as it is the cheapest raw material for making pure hydrogen for the synthesis of methanol and other chemicals and for the hydrogenation of coal.

The book is the first section of a new textbook on gas manufacture, and attention is consequently devoted also to oil cracking and the subject of the complete gasification of coal. The gas industry is known to be steadily developing technically under close scientific supervision and without any spectacular expenditure of capital, and the way is clear for

the more extensive application of processes of carbonisation and gasification, thus eliminating the waste resulting from burning raw coal.

Water gas by itself is too low in calorific value to be used as town's gas, accordingly it is enriched with the gas produced by cracking oil: both the theory and practice of this operation are fully described in the book. A desideratum of the gas industry is often said to be a process by which raw coal may be gasified in a single stage, thus combining the ordinary processes of carbonising to coke and the conversion of coke into water gas: the state of knowledge in this subject is set out by Mr. Griffith. A section on temperature measurement is contributed by Mr. H. C. Exell.

Elements of Heat-Power Engineering. By Prof. William N. Barnard, Prof. Frank O. Ellenwood and Clarence F. Hirshfeld. Part 2: *Steam-Generating Apparatus and Prime Movers, Fuels, Combustion and Heat Transmission.* Pp. xi+871. 34*s.* net. Part 3: *Auxiliary Equipment, Plant Ensemble, Air Conditioning and Refrigeration.* Pp. ix+781–1200. 28*s.* net. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.)

TWENTY-TWO years have passed since Prof. Barnard, of Cornell University, and Dr. Hirshfeld, of the Detroit Edison Company, brought out the first edition of their "Heat-Power Engineering". In that interval power station practice has made enormous strides; stations are far larger, units more powerful, installations more complex and thermal efficiencies much higher. With these advances there is every need for frequent revision of textbooks, and in the rewriting of this work Prof. Ellenwood, also of Cornell, has collaborated.

Part 1 of the work, it may be said, deals mainly with thermodynamics; Part 2 is devoted to steam turbines and engines, boilers, heat transmission, fuels, furnaces, combustion, superheaters, economisers and other plant found in central stations, and Part 3 to auxiliary equipment, plant ensemble, air conditioning and refrigeration. There are plenty of sketches, graphs and problems, and though the field covered is necessarily a very wide one, an excellent index makes reference easy. It is a mine of information and should be on the bookshelves of every technical college.

The Alloys of Iron and Tungsten. By J. L. Gregg. (Alloys of Iron Research Monograph Series.) (Published for the Engineering Foundation.) Pp. xii+511. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 36*s.* net.

As a result of the rapid growth of metallurgical knowledge, the difficulty found by new workers in collecting the existing information on any branch of the subject is becoming increasingly great. In an endeavour to overcome this, the American Engineering Foundation is publishing a series of monographs on the alloys of iron with the more important elements. So far, two volumes, dealing with molybdenum and silicon respectively, have appeared, the latest being concerned with the ferrous alloys containing tungsten. The abstracting is excellently done, and the information is clearly and logically presented. At the end of each chapter, the author has summarised the main conclusions which have been reached, not always an easy task as there is here and there some lack of concordance between the results of different workers. For the most part, however, the individual researches are considered uncritically—an eminently desirable procedure in the production of a book of the present type—and as a result it is at once clear where there is room for further work. The service which is being rendered to metallurgy by the publication of these monographs can scarcely be overestimated. This latest addition is most heartily to be welcomed, whilst the others in course of preparation on pure iron and its alloys with carbon, nickel and copper will be eagerly awaited. F. C. T.

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McGraw-Hill Publishing Co., Ltd.—The Theory and Practice of Silviculture, F. S. Baker; Forest Mensuration, D. Bruce and F. X. Schumacher; Economics with Applications to Agriculture, E. F. Dummeier and R. B. Heflebower.

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contains a workroom, kitchen, verandah, and dormitory accommodation, etc. The site is about half an hour's walk from the Narrabeen tram terminus, and is within easy reach of French's Forest, Kuring-gai Chase, Deep Creek and Long Reef. It provides therefore an excellent centre for the study in their native habitats of the fauna and flora of sandstone scrub, forest, palm groves, fresh-water swamps, lagoons and beaches. The neighbourhood is also a sanctuary for native birds The research work to be done at this station, which is the first of its kind to be founded in Australia, will range from simple individual work to extended studies by teams of observers, in which botanists, zoologists and geologists may all take part. Among interesting researches which stand to the credit of senior members of the Society are Prof. W. J. Dakin's work on the food and breeding habits of the fish in Australian coastal waters, and Prof. T. G. B. Osborn's researches on Australian native fodder plants and grasses. The new station will also allow biological students to carry out under ideal conditions the field work which forms part of their training.

Early Plant Hybridisation

FURTHER records of plant hybridisation before Kölreuter are given by Dr. C. Zirkle (*J. Heredity*, **25**, No. 1), his earlier studies of this subject having been reviewed in NATURE of March 18, 1933, p. 393. Many early writers noted different coloured grains on the same ear of maize, the earliest recorded being by Tabernaemontanus (1588). Cotton Mather, in a letter to James Petiver in 1716, which is preserved in the Sir Hans Sloane collection of the British Museum, described natural crossing between different colour varieties of maize. This letter is published in full. Crossing in *Cucurbita* was also described. Thomas Fairchild is generally credited with having produced the first artificial plant hybrid, about 1716. From records of Richard Bradley and the minutes of the Royal Society it is concluded that the hybrid first appeared spontaneously, and was then produced by crossing a carnation as female with the pollen of a Sweet William. Bradley himself recorded *Auricula* hybrids in 1717 and commented on the effect of foreign pollen in several varieties of apples and melons. Other English hybridisers of the same period are Thomas Knowlton, whose observations on *Dianthus* species hybrids were reported to the Royal Society in 1720; Thomas Henchman, Prebendary of Salisbury, who in 1729 noted the crossing of pea varieties and the occurrence of blue and white seeds in the same pod; and Benjamin Cooke, who in the Isle of Wight described crossing between maize varieties in 1749 (*Phil. Trans. Roy. Soc.*, vol. 46). Twelve different investigators have now been found who described plant hybridisation before Kölreuter.

Spread of the Water Hyacinth

IN tropical waters, the water hyacinth, *Eichhornia crassipes*, Solms., a native of South America, a freely floating or loosely attached water plant supported by its curious buoyant bladder-like petioles, very readily becomes a serious pest, blocking waterways to navigation and converting fertile land near the waterways into stagnant swamps. F. P. Jepson, controller of plant pests, Department of Agriculture, Ceylon, has directed attention to the spread of this pest (*Trop. Agric.*, 81, Dec. 1933). Introduced into Ceylon in 1905, probably as an ornamental plant, it has spread until in 1933 it ranges over some thousands of acres of water, paddy and swamp. At present, the infested areas lie within the inhabited zones, but Mr. Jepson contemplates with dismay the possible results of its finding its way to the vast uninhabited regions traversed by some of the larger rivers. Chemical methods of extinction are still being experimented with, but until now removal by hand has been most effective, the weed being then piled up and burnt. The chief difficulty in the control of the pest has been the apathy of the landowners and others responsible for the irrigation dams and water tanks. For this reason, Mr. Jepson's account is written in an educational and propagandist spirit, and makes clear the necessity for co-operation between private individual and Government if the water hyacinth is to be brought under control.

"Marmite"

THE yeast extract "Marmite" has long been recognised as a source of the vitamin B complex; more recently it has been found of value in various types of anæmia. Marmite has been compared directly with the international standard vitamin B_1 preparation and found to contain 840 international units per oz., so that it is a potent source of this vitamin. It contains also vitamin B_2 and other substances extractable from yeast, among which may be mentioned the 'extrinsic' factor required for normal blood formation. It is now generally considered that normal hæmatopoiesis depends upon the interaction of an 'intrinsic' factor present in the juice secreted by a healthy human stomach and an extrinsic factor present in the food: the compound formed by the interaction of these two factors is stored in the liver. In true pernicious anæmia, there is a deficiency in the secretion of the intrinsic factor, so that cure can only occur when the complete hæmatopoietic factor is supplied, as by giving liver or a preparation of it. In other anæmias, such as tropical macrocytic anæmia, it appears that the intake of the extrinsic factor is deficient; cure can then be brought about by administering marmite. The effectiveness of marmite in anæmia is not due apparently to any constituent of the vitamin B complex present in the extract. Marmite is supplied by the Marmite Food Extract Co., Ltd., London, E.C.3.

Fog Peril to Fishermen Lessened

THE United States fishermen who use dories (small flat-bottomed boats) to fish on the Grand Banks run a serious risk of drifting out to sea in a fog. This danger can now be very successfully overcome by the use of small radio transmitting sets weighing 20 lb. which can signal the position of the scattered

boats to the 'mother' fishing ship. As a boat sets out fishing, it carries one of these sets. When the work is done, if there is a dense fog, the dory sends out a code signal to the mother ship. By means of the radio direction finder the ship carries, the direction of the dory from it is easily found. Tests made from a schooner show that dories can be located up to a distance of six miles. The battery used can give out signals for a week. A description of the method is given in *Electronics* of August.

Japanese Mathematical Journals

IT is interesting to notice how largely the English language is used in some Japanese scientific journals. The *Tôhoku Mathematical Journal* accepts contributions in English, French, German, Italian or Japanese, but of the thirty-three papers in vol. 39, part 2, no less than twenty-four are in English, and only one is in Japanese. The authors are of decidedly varied nationalities, including ten Americans, nine Japanese, four British, three Chinese, two Germans, and one Russian. The subjects treated belong almost entirely to the domain of pure mathematics, with an unusually large proportion of geometry of various kinds (pure, algebraic and differential). The papers in this *Journal* are usually very short. We have also received Science Reports of the Tokyo Bunrika Daigaku (Section A, 2, Nos. 31–32), which contain two mathematical papers of greater length, one in English and one in German, both by Japanese authors.

The Trees of Ireland

THE mild, moist climate of Ireland is particularly favourable to the growth of trees, and Mr. H. M. Fitzpatrick has done a valuable service to both foresters and botanists in gathering together (*Sci. Proc. Roy. Dublin Soc.*, 41, November 1933) particulars of the trees introduced into Ireland, and as to where specimens of these trees may be found. Statistics of tree dimension have been collected from no less than seventy-two estates. The wide variety in conifers is particularly striking in the list. Mr. Fitzpatrick states that broad-leaved trees have been less and less in fashion since the introduction, about 1840, of many of the North American conifers, which flourish so remarkably in the Irish climate.

Guide to Official Statistics

THE volume for 1933 of the "Guide to Current Official Statistics" (H.M. Stationery Office. 1*s*.) has now been published. The main part of the volume is an alphabetical subject index of nearly three hundred pages giving the number of the publication involved. This is followed by a list of publications in serial order which allows the title and price of the blue book or white paper to be found. The indexing is done in much detail, and there should be no difficulty in finding the statistics required. With the help of this annual publication, much valuable information in official volumes is made available to students.

Announcements

LORD MELCHETT will speak on "National Progress in relation to the Monetary System" at a meeting of the Engineers' Study Group on Economics on October 24 at 8 p.m. at Denison House, Victoria, S.W.1. Admission is by tickets, obtainable free of charge from Mr. A. H. Hayes, Hazlitt House, Chancery Lane, W.C.2.

THE following appointments have been made in the Colonial Empire: Mr. L. D. E. F. Vesey-Fitzgerald, to be entomologist to the Sugar-Cane Investigation Committee, Trinidad; Mr. R. A. Hamilton, to be assistant chemist to the Sugar-Cane Investigation Committee, Trinidad; Mr. G. D. Huggins, assistant agricultural superintendent, British Guiana, to be agricultural superintendent, British Guiana; Mr. J. V. Collins, deputy Government analyst, Ceylon, to be Government Analyst, Ceylon; Mr. G. W. St. C. Thompson, formerly botanist, Tsetse Research Department, Tanganyika Territory, to be Assistant Conservator of Forests, Gold Coast.

IT is announced from the Royal Institution that single tickets admitting to one afternoon lecture can now be obtained by non-members. Books of single tickets, which are transferable, are also available, and season tickets for the sessions before and after Christmas respectively can be obtained.

THE Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals will shortly be making awards from the Beilby Memorial Fund. These awards are given to British investigators in science to mark appreciation of records of distinguished original work, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy. The administrators of the Fund will be glad to have their attention directed, not later than October 27, to outstanding work of the nature indicated. Correspondence should be addressed to the Convener, Sir George Beilby Memorial Fund, Institute of Chemistry, 30 Russell Square, London, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A senior lecturer in physics at the Military College of Science, Red Barracks, Woolwich, S.E.18—The Commandant (Oct. 31). A professor of economics at Armstrong College, Newcastle-upon-Tyne—The Registrar (Nov. 12). A temporary assistant metallurgist at the Research Department, Woolwich, S.E.18—The Chief Superintendent. An irrigation adviser to the Palestine Government—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1. A lecturer in physics at the University of Rangoon (University College)—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1. An assistant in the Mechanical Engineering Department of Guildford Technical College—The Director, Technical College, Park Street, Guildford. An assistant in radio research in the Directorate of Scientific Research of the Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hampshire.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Language Distribution of Scientific Periodicals

The recently issued second edition of the "World List of Scientific Periodicals" (see NATURE, Sept. 22, 1934) provides a census of the current scientific periodicals throughout the world. The detailed thoroughness of the work, executed under the editorship of Mr. W. A. Smith, of the British Museum, with an expert staff, the advantage taken by them in regard to comprehensiveness of entry, from experience gained in the first edition now nine years ago, and the very magnitude of the list arrived at, extending to more than 36,000 individual titles, allow the supposition that in this conspectus we have the total current output of scientific periodicals of the world represented with something like exhaustive completeness.

To-day periodicals constitute the main bulk of scientific literature. They furnish the main channel for publication of new scientific discoveries and inventions. They form a chief medium for the exchange and discussion of new views. They can be accepted therefore as constituting in large measure an index to scientific activity. For obtaining a view of the contributions to scientific activity furnished from different parts of the world, an interest attaches therefore to the quota, toward the general output of such periodicals, traceable severally to some of the main contributory groups throughout the world. To assess this the number of titles belonging to a given language as recorded by the "World List" may be taken as some guide. The "World List" itself covers eighteen different languages. Without carrying the inquiry further than the five languages English, French, German, Italian and Russian, the results come out, following them in reverse order to the above, as follows :

Russian . .	1,833	scientific periodicals.
Italian . .	1,667	,, ,,
German . .	6,186	,, ,,
French . .	5,013	,, ,,
English . .	13,494	,, ,,

Relatively one to another, the numerical sizes of these groups may be accepted as carrying some indication as to how scientific activity bulks relatively under these several linguistic headings. Scientific production will obviously be a part of the scientific activity thus indexed. An inference also allowable, within limits, will be as to the relative size of that fraction of the world-public which is reached by science through the medium of each of the several languages. The results cited above make evident the special responsibility resting on those contributors to science whose language is English to spare no pains to write it worthily of the great rôle entrusted to it as a medium of scientific thought to-day.

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Wine Makers and Bottle Makers: a Parable

A certain country was noted for its wonderful native wines, both sparkling and mellow. Grapes were grown by small individual owners, and each specialist was proud of his product and of its distinct taste. For fermentation and ageing, wine was poured into various casks, skins, bottles, jugs, etc., as the case might be. From time to time there was some talk about the containers being not always satisfactory and certainly not uniform. Gradually the makers of bottles and jugs organised an association to improve and to standardise their products, so as to provide the wine makers with better containers and thereby to assist them both in the production and marketing of the wines.

It so happened that while it was easy for the bottle makers to become organised (their product being standard and comparatively easy to manufacture), the wine makers continued their individual production, at least for the choicest vintages, where intimate individual knowledge, skill and professional pride were important factors. As time went on, there was more and more talk about excellent bottles and less and less talk about the wines themselves, because the organised bottle makers had better publicity channels. In some cases fancy mass-production bottles began to be used for mediocre wines, thus discouraging the best viniculturists.

To make the situation worse, the bottle makers conducted their activities as part of the wine making industry, and the wine makers were only invited from time to time as a favour to sit with them in their discussions. To make the camouflage complete, the bottle makers adopted for themselves the honorary degrees which the wine makers originally used to bestow upon their own distinguished confreres, such as Master of Fizz and Doctor of Fermentation, although the recipients from among the bottle makers did not even understand the meaning of the words. Every time an intricate technical problem in wine making arose, the bottle makers appointed an elaborate committee of their own men, with the final result that a bottle of a somewhat different shape was recommended as a remedy, even though the difficulty may have been of chemical or bacteriological nature.

The bottle makers' association grew and prospered. Not satisfied with bottles for wine, the association appointed representatives to sit on joint committees with makers of other kinds of containers, such as bath-tubs and garbage cans, it being assumed that they had much in common. In the meantime, less and less of exquisite rare wines began to be produced, and more and more of 'vin ordinaire' of uniformly sour taste, sold in various fancy bottles. Finally, the more discerning consumers from abroad ceased buying wine from this particular country, and warehouses became filled with empty bottles of all kinds of fancy shapes. Some of the wine growers went into other pursuits, some continued outside the association, and some began forming small professional circles of their own, very simple in external form, and devoted exclusively to real improvements in the quality of wines and general theory of grape culture and fermentation. Full membership was restricted to actual grape growers and wine makers; anyone interested as an amateur could become an associate member, but bottle makers were strictly excluded. In some circles, to be admitted one even

had to prove that neither of his grandfathers was a bottle maker or related to one.

In the end the cycle was completed and the wine growers again acquired the prominence due them, while the bottle makers' association became too top-heavy to continue to exist. Individual bottle makers found their proper modest function furnishing simple reliable bottles as specified by the wine makers. From the temporary flare-up, when the bottle makers came near ruining the wine industry by their over-zealousness and naïve conceit, some of the puzzling old sayings originated, such as, "tell your troubles to the bottle makers", or "try a different shape bottle".

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Nuclear Structure and Excited Radioactivity

FOLLOWING Heisenberg and Landé's suggestion, completed by Walke[1], every atomic nuclear can be considered as constituted by α-particles (α), deutons (π_2) and neutrons (n), according to the formula :

$$x\alpha + y\pi_2 + zn.$$

x, y, z must satisfy the equations

$$4x + 2y + z = A$$
$$2x + y = N$$

where A is atomic mass, N atomic number. For x one must choose the greatest possible value, when $y = 0$ or 1.

An examination of the table of all isotopes shows that the following formulæ

$$(1)\ \begin{cases} x\alpha + \pi \\ x\alpha + \pi_2 \text{ (for } x > 3) \\ x\alpha + \pi_2 + \pi \end{cases} \quad (2)\ \begin{cases} x\alpha + \pi_2 + zn \ (z \text{ even}) \\ x\alpha + zn \ (z \text{ even}, x < 4) \end{cases}$$

do not correspond to any known stable isotope. It should be noted here that $x\alpha + \pi$, $x\alpha + \pi_2 + \pi$ do not agree with the general form $x\alpha + y\pi_2 + zn$; they correspond to exceptions. It may therefore be concluded that they represent nuclei of unstable isotopes. It is easy to see that formulæ (1) lead to a positive electron emission ; the formulæ (2) to a negative electron emission.

The formula for nuclear structure also makes it possible to predict the reactions involved in artificial radioactivation.

The various possible cases are :

(1) $y = 1$, z odd, nuclear formula $x\alpha + \pi_2 + zn$;
(2) $y = 1$, $z = 0$, nuclear formula $x\alpha + \pi_2$;
(3) $y = 0$ nuclear formula $x\alpha + zn$.

In each case, it is easy to investigate the action of the various particles : α-particles, protons, deutons or neutrons ; and always we arrive at a formula of an unstable isotope.

For example, in case (1) the neutrons give :

$$(x\alpha + \pi_2 + zn) + n = x\alpha + \pi_2 + (z + 1)\,n$$
$$\text{or } [(x - 1)\alpha + \pi_2 + (z + 1)n] + \alpha\uparrow$$

two possible reactions which lead to two various periods (${}_9F^{19}$, ${}_{11}Na^{23}$, ${}_{13}Al^{27}$ . . .).

In case (2), the α-particles give

$$(x\alpha + \pi_2) + \alpha = [(x + 1)\alpha + \pi] + n\uparrow \quad ({}_3Li^6,\ {}_5B^{10},\ {}_7N^{14}).$$

In case (3), the neutrons give

$$(x\alpha + zn) + n = [(x - 1)\alpha + \pi_2 + (z + 2)n] + \pi\uparrow,$$

the resulting nucleus being unstable if z is even or zero (${}_{12}Mg^{24}$, ${}_{14}Si^{28}$, ${}_{16}S^{32}$, ${}_{26}Fe^{56}$ . . .).

A full account of the results will appear shortly in the *Annales de la Société scientifique de Bruxelles.*

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Sept. 15.

[1] Walke, *Phil. Mag.*, **17**, 793 ; 1934. **18**, 129 ; 1934.

Ionisation of Gases by Atom Beams

ON the ionisation of gases by particles of atomic mass (ions and atoms) very few results have been obtained hitherto. As regards neutral atoms with moderate energy (less than 1,000 electron-volts), the only available data are those referring to the effective cross-sections for ionisation of argon by argon atoms with 500 and 650 e.v. energy, as determined lately by O. Beeck and H. Wayland[1] ; earlier work by Beeck and by C. J. Brasefield[2] being of a rather qualitative character, and their results uncertain.

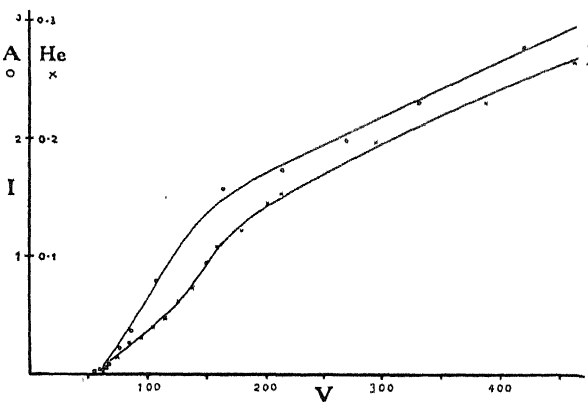

FIG. 1.

I have been able lately to determine the effective cross-sections for ionisation of argon and helium by their own atoms with an energy varying between 50 and 700 e.v. The values are given in the accompanying diagram (Fig. 1). Both curves fall abruptly at small values of the energy, and they both reach the abscissa at a value of nearly 60 e.v. The value of the cross-section for helium is about a tenth of the corresponding values for argon. A full account of the investigation will be published *in extenso* in *Nuovo Cimento*[3].

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R. Istituto fisico, Torino.
Aug. 29.

[1] O Beeck and H. Wayland, *Ann. Phys.*, **19**, 129 ; 1934.
[2] O. Beeck, *Proc. Nat. Acad. Sci.*, **18**, 311 ; 1932. *Z. Phys.*, **76**, 799 ; 1932. C. J. Brasefield, *Phys. Rev.*, **42**, 11 ; 1932. **43**, 785 ; 1933.
[3] See also *La ricerca scientifica*, July–August, 1934.

Specific Gravity of Lapis Lazuli

IN the course of some work on lapis lazuli, we were astonished to find how wide was the discrepancy between the specific gravities of our specimens and the values accorded to this rock by all the standard textbooks. Of more than five hundred representative specimens examined, we found that 95 per cent had specific gravities falling within the range 2·75–2·90, the extreme limits being 2·45 and 2·94. Ever since the 1850 edition of Dana's "System", the figures almost universally quoted have been 2·38–2·45. This value is derived from Breithaupt's "Handbuch" (1847), in which he states that he found the density of "quite pure grains" to be 2·406, and gives as the range 2·38–2·42. 2·5–2·9 (Dana's "System" 1844 Ed.) and 2·76–2·95 (Brisson : "Pésanteurs Spécifiques des Corps", Paris, 1787) are examples of the better values given prior to Breithaupt.

As the specific gravity provides a constant of considerable importance for testing purposes, it is to be hoped that future works on mineralogy will revert to more representative figures for this widely-used material.

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Chemistry of Anaerobic Recovery in Muscle

The three series of major chemical changes which are associated with muscular activity, namely: disintegration and resynthesis of adenosinetriphosphoric acid; disintegration and resynthesis of phosphocreatine; and glycogenolysis, or transformation of glycogen into lactic acid, have been considered, until recently, as independent chemical reactions, but as in some way linked—energetically and chemically. It was known that the presence of adenosinetriphosphoric acid is a condition of glycolysis in muscle, and that glycolysis is a condition of the resynthesis of adenosinetriphosphoric acid from adenylic acid and phosphates. Recently it has been made clear, by Lohmann[1], that the resynthesis of adenosinetriphosphoric acid from adenylic acid is brought about by splitting off phosphate groups from phosphocreatine; at the same time, we have demonstrated[2] the linkage between glycogenolysis and the resynthesis of adenosinetriphosphoric acid, depending probably on the intermediate resynthesis of phosphocreatine, and this later linked to a definite intermediate step of glycogenolysis.

Taking into consideration some further facts, for example, that the dephosphorylation of adenosinetriphosphoric acid does not lead, in iodoacetate poisoned muscle, to free phosphates, but to carbohydrate-phosphoric esters, we come to certain conclusions concerning the linkage of the three series, which can be pictured, tentatively, in the following equations:

1. $$\underset{\text{adenosinetriphosphoric acid}}{C_5N_5H_4.C_5H_8O_4.PO_3H.P_2O_6H_3} + \underset{\text{glycogen}}{\tfrac{1}{n}(C_6H_{10}O_5)_n} + H_2O = \underset{\text{adenylic acid}}{C_5N_5H_4.C_5H_8O_4.PO_3H_2} + \underset{\text{fructosediphosphoric ester}}{C_6H_{10}O_6(PO_3H_2)_2}$$

2. $$C_5N_5H_4.C_5H_8O_4.PO_3H_2 + \underset{\text{phosphocreatine}}{2C_4H_7N_3O_2.PO_3H_2} = \underset{\text{adenosinetriphosphoric acid}}{C_5N_5H_4.C_5H_8O_4.PO_3H.P_2O_6H_3} + \underset{\text{creatine}}{2C_4H_9N_3O_2}$$

3. $$\underset{\text{fructosediphosphoric ester}}{C_6H_{10}O_6(PO_3H_2)_2} + \underset{\text{creatine}}{2C_4H_9N_3O_2} = \underset{\text{lactic acid}}{2C_3H_6O_3} + \underset{\text{phosphocreatine}}{2C_4H_7N_3O_2.PO_3H_2}.$$

The third reaction is obviously simplified; the second is Lohmann's reaction. It will be noted that the ultimate effect of the whole transformation is the conversion of glycogen into lactic acid; and that the three series appear as intermediate reactions in this conversion.

We consider the above changes as the main course of the changes connected with anaerobic recovery, to which, of course, the well-known minor changes, such as ammonia formation from adenylic acid, are subsidiary reactions.

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Sept. 2.

[1] C. Lohmann, *Biochem. Z.*, **271**, 264, 278; 1934.
[2] J. K. Parnas, P. Ostern, T. Mann, *Biochem. Z.*, **272**, 64; 1934.

Effect of the Male Sex Hormone on the Genital Tract of the Female

BROUHA and Simonnet[1] have already given evidence that testicular extracts produce œstrus in castrated rats, as shown by the cornification test, causing also the proliferation of the uterine mucous membrane in immature female rats. A similar reaction has been observed after injections of the male hormone extracted from the urine (hombreol)[2]. The horns of the uterus increase, their lumens fill up with the excreted fluid, the glands and muscular layers are better developed and the epithelial cells become elongated. These changes are comparable to those caused by the female sex hormone. The fact that both the female and the male hormones affect the genital tract of the female similarly is, I think, in accord with the results of recent biochemical work[3,4]. It is interesting to note that the proliferational changes are most striking in animals treated simultaneously with the male and female hormones.

Analogous changes, though perhaps less accentuated as regards the glands and epithelium, can be induced by the male hormone in rabbits 10–60 days old. Ten day old female rabbits give a macroscopic positive reaction (increase of the uterus and its hyperæmia) and also a positive microscopic reaction on the day after the last of three subcutaneous injections given every second day and containing a total of about 15 capon units.

This test can therefore be used in examining the activity of preparations free from the greater quantities of the female sex hormone; it gives satisfactory results on unoperated animals without histological examination of the uterus wall. Younger animals (4–5 days old) react in a lesser degree. In this connexion, it is perhaps worth stating that, in immature female rabbits, the male and female hormone (in the proportion of 1 c.u. to 10 m.u.) produce quantitatively the same effect, and that the female organism does not react earlier in its development to the female hormone than to the male hormone.

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Sept. 21.

[1] *C. R. Soc. Biol.*, **99**; 1928.
[2] St. Skowron and E. Turyna, *Pol. Gaz. Lek.*, Nr. 18; 1934.
[3] W. Schoeller, E. Schwenk and F. Hildebrandt, *Naturwiss.*, Jahrg. **21**, 1933.
[4] W. Dirscherl and H. E. Voss, *Naturwiss.*, Jahrg. 22, 1934.

A New Glycoside from Madder

ALIZARIN and purpurin have always been described as the two chief tinctorial substances of madder. I have found that the purpurin obtained from madder does not derive from a previously suspected purpurin glycoside but from a glycoside of pseudopurpurin. (Alizarin is 1 : 2-dihydroxyanthraquinone, purpurin is 1 : 2 : 4-trihydroxyanthraquinone and pseudopurpurin is purpurin 3-carboxylic acid.)

While ruberythric acid (the alizarin glycoside) has been known for many years, the second tinctorially important glycoside of madder has not been previously isolated; though its presence was first recognised by Kopp in 1861. A glycoside of pseudopurpurin has now been prepared by me from the roots of the wild madder (*Rubia peregrina*) and the yellow bedstraw (*Galium verum*). The substance is very soluble in water, from which it readily crystallises in minute needles, and forms a bright yellow powder, showing no definite melting point owing to decomposition. It appears to be a 1-monopentoside of pseudopurpurin, and is very easily hydrolised. It can be isolated as follows. Fresh roots being extracted with boiling water, normal lead acetate precipitates the crude glycoside. The precipitate is extracted with 1 per cent acetic acid, impurities removed by the addition of more lead acetate, and then ammonia throws down a purer lead compound which is decomposed by 1 per cent H_2SO_4. The glycoside is extracted from the acid solution with butyl alcohol, and then removed by aqueous ammonium carbonate. The ammonia being blown off by air on a water bath, the warm concentrated aqueous solution gives crystals of the glycoside on cooling.

As the glycoside of pseudopurpurin is found only in the genera of the tribe *Galieæ* of the *Rubiaceæ*, the name '*galieide*' is suggested for this substance.

Galieide is responsible for the dyeing properties, known in antiquity, of our native bedstraws (*Galium*). Alizarin occurs only in small quantities in a few species, but the dyers' madder (*Rubia tinctorum*), which is scarcely found apart from cultivation, yields equal quantities of alizarin and pseudopurpurin. Alizarin was the most useful constituent from the dyers' point of view as it was the only one involved in the dyeing of turkey red with madder. The wild madder (*R. peregrina*) has strong tinctorial properties due mainly to galieide, and contains only a negligible amount of alizarin.

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Microchemical Detection of Elementary Sulphur

THE only method so far known for the detection of small amounts of *elementary* sulphur is unsatisfactory: it consists, in principle, in isolation of the free sulphur of the material under test by sublimation or extraction, followed by examination of the crystal form and of the chemical reactions. Fractions of a milligram of elementary sulphur cannot be detected by this method, and it also fails with larger amounts if the sample contains organic substances which, like sulphur, sublime and have similar solubility.

The following method, which is free from the above disadvantages, has been worked out, chiefly for the purpose of detecting free sulphur, in the presence or absence of combined sulphur, in biological material. The substance to be tested is thoroughly ground with benzylimido-di-(*p*-methoxyphenyl)-methane (I) and a sample of the mixture is introduced into a melting point tube. The tube is placed for five minutes in a bath previously heated to 210° and then the contents of the tube are extracted with a few drops of benzene. If the substance contains elementary sulphur the extract is coloured blue. This blue colour decreases in intensity within a few hours if a crystal of mercuric chloride is added, and the surface of the crystal acquires an intense red colour. The blue colour appears as the result of the formation of the blue thioketone, *pp'*-dianisylthioketone (II), whilst the red colour is due to the formation of an addition compound of the thioketone and mercuric chloride. The addition compound has the constitution (III) or (IV).

Very small amounts (0·04 mgm.) of elementary sulphur can be detected without difficulty by this method. The reagent (I) does not react with combined sulphur.

$$Ar = p-CH_3.O.C_6H_4-$$

$$\text{(I) } Ar_2 : C : N.CH_2\,C_6H_5 \xrightarrow{S} Ar_2 : C : S \text{ (II)}$$

$$\text{(III) } Ar_2 : C : S \ldots\ldots Hg\,Cl_2 \qquad [Ar_2 : \underset{\textstyle S\,HgCl}{C}\,]\,Cl \text{ (IV)}$$

The reagent (I) is obtained by the action of benzylamine on the chloride of dianisylketone ($Ar_2 : C : Cl_2$), or by the action of dianisylthioketone (II) on benzyl azide ($C_6H_5.CH_2.N_3$).

My thanks are due to W. Urban for his co-operation in this work.

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The *p*H of Serum Inactivated by Heat

WE have shown, in recent years, that the inactivation of serum, or destruction of alexin by heat, is accompanied by a number of physical or physico-chemical phenomena which characterise the critical temperature of 55°–57° C. They are: increase in viscosity (after an absolute minimum around 56°[1]), increase in rotatory power[2], increase in absorbed light[3], increase in scattered light[3], increase in the factor of depolarisation[4], increase in electric resistivity[5], sharp change in the rate of sedimentation of globulins after dilution with water[6], decrease in the amount of ether fixed by shaking[7], change in the interfacial tension against oils[8]. A new phenomenon is to be added to the list, namely, an increase in the hydrogen ion concentration, expressed by a drop in the *p*H.

Up to the present time, the data provided by literature were scant and contradictory. Lieberman, Tangl (1907), Seligman (1908), Hugo Hecht (1923), for example, state that inactivation of serum is accompanied by an alkalinisation, while Michaelis and Rona (1909) and Davidsohn (1910) found that no change greater than the experimental errors took place. Sörensen and Jürgensen (1911–13), who worked on the *p*H of serum, did not work under the same conditions and studied mainly coagulation after acidification at *p*H 4·70.

In order to make a very large number of determinations of pH of serum under the best possible conditions of accuracy, rapidity and ease, we developed a new rotating hydrogen electrode[9], which enabled us to reach the third decimal point in about five minutes, with 0·4 c.c. of liquid. Three or four bubbles of hydrogen, containing carbon dioxide in equilibrium with the samples under experiment, are required. Good temperature control by circulating water around hydrogen and calomel electrode is provided.

Under such conditions we found that, after heating for 10 minutes in sealed tubes, a lowering of the pH always takes place. The minimum is usually observed around 60° C., but sometimes at 62° and even 63°. After the minimum of acidification is reached, the value of the pH fluctuates around this value, and sometimes shows a marked tendency towards higher pH values (alkalinisation).

This is true of all sera studied so far (mammals), whether pure or diluted with isotonic solution, provided the serum is handled throughout under a layer of neutral paraffin oil in order to avoid the loss of carbon dioxide. Failure to prevent this loss explains the alkalinisation reported by previous workers, and the lack of sensitivity of the method of measurement accounts for absence of variation reported by the others. The amplitude of the drop in pH is indeed small, and its mean value (more than four thousand experiments were made) is 0·05 pH. The extremes observed were 0·03 and 0·07 pH.

Increase in the time of heating does not result in an increase in the amplitude of the drop. The only difference observed is its displacement towards lower temperatures: the minimum occurs around 58°. When the serum is diluted with isotonic solution before heating, the amplitude of the drop is increased (up to 0·1 pH), and shifted towards higher temperatures, and the decrease begins around 55°.

P. Lecomte du Noüy.

Institut Pasteur,
Paris.
Oct. 2.

[1] Lecomte du Noüy, *Ann Inst. Pasteur*, **42**, 742; 1928. *J. Gen. Physiol.*, **12**, 363; 1929.
[2] Lecomte du Noüy, *Ann. Inst. Pasteur*, **43**, 749; 1929.
[3] Lecomte du Noüy, *Ann. Inst. Pasteur*, **44**, 109; 1930.
[4] Lecomte du Noüy, *Ann. Inst. Pasteur*, **45**, 251; 1930.
[5] Lecomte du Noüy, *Ann. Inst. Pasteur*, **50**, 127; 1933.
[6] Lecomte du Noüy, *Ann. Inst. Pasteur*, **48**, 187; 1932.
[7] F. Seelich, *Biochem. Z.*, **250**, 549; 1932. **268**, 34; 1934.
[8] F. Seelich, *Biochem. Z.*, (in press).
[9] Lecomte du Noüy, *C.R. Acad. Sci.*, **193**, 1417; 1931. *Science*, **75**, 643; 1932.

Whales and Caisson Disease

Prof. Krogh's interesting comments[1] on the physiology of the blue whale and how it escapes caisson disease stimulate further speculation. Capt. Damant[2] suggested that at ten atmospheres' pressure below the surface the whale's lungs and the gaseous contents might be compressed to one tenth of the normal volume and in this way the absorption of nitrogen might be retarded. Prof. Krogh replied that he could not picture the whale's thorax and lungs compressed to this extent.

There is another possibility not yet recorded so far as I know. When the whale submerges deeply it may not contain any gas in its lungs at all. It may fill its lungs with sea-water and in this way avoid all extreme compression of lung tissue. Also, as there is no free nitrogen gas in the lung, in such a case all danger of bubble formation in the tissues is excluded. This theory assumes that the whale is able to do without oxygen for considerable periods, after it has breathed at the surface. The animal may accumulate a considerable oxygen debt under water. The water freed from the whale when it blows has always appeared to me to be too substantial to be merely vapour mixed with air from the lungs. The whale may tolerate sea-water in its lungs.

J. Argyll Campbell.

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Oct. 8.

[1] Nature, **133**, 635, April 28, 1934.
[2] *ibid.*, p. 874.

Science at the Universities

I am grieved to infer, from his letter in Nature of October 13, that Prof. Haldane thinks that I have no soul. The skittle that he knocks down with such gusto is not mine. If he had read my address with more care, he might have discovered that the remarks which he quotes have no bearing on the question how far a knowledge of biology is useful to the average citizen: they refer solely to the danger of encouraging too many students to study intensively a highly specialised branch of knowledge. Let me ask him two questions:

(1) Does he really think that a highly specialised training in any branch of knowledge is an essential ingredient of good citizenship?

(2) Which is more likely to make a man a good citizen? To find that the world wants him, or to find that it does not?

Prof. Haldane really ought not to stupefy himself with catch-phrases. He accuses me of regarding biologists as mere commodities. A commodity is a useful thing with a marketable value. I have not the least objection to being regarded as a commodity in that sense; nor have I any reason to believe that biologists, as a class, are more sensitive. What a "mere commodity" means, I do not know; except that one says "mere" when one wants to be vaguely insulting. But the insult is Prof. Haldane's; not mine. He thinks that my opinions will encourage "revolutionary views" among university students. Let me assure him that it seldom worries a young man to find that he has a good marketable value; what worries him is to find by bitter experience, after years of intensive study, that he has little or no marketable value.

H. T. Tizard.

Oct. 15.

The Philosophy of Sir James Jeans

Dr. Campbell[1] seems himself to have missed the point. I agree with him (though I should not so express it) that "there is not nearly as much difference between the old and the new as Jeans, Eddington and their followers pretend". This was—obviously, I should have thought—my contention in the original article. The point at issue with Dr. Jeffreys is whether the "old" science *realised its character* so well as the "new"—quite a different thing.

H. D.

[1] Nature, **134**, 571, Oct. 13, 1934.

Research Items

Heredity and Disease in Man. Dr. L. S. Penrose's Buckston Browne prize essay is a discussion of heredity as a factor in human disease, and is written from the medical point of view (London: H. K. Lewis and Co., Ltd. 5*s*. net). The obsolete term "unit characters" is retained, and the author makes a slip in stating that "characters" are arranged within the chromosomes. Nevertheless, a serious and, to a considerable extent, successful attempt is made to harmonise the genetical and statistical points of view as regards inheritance. Among other results is included a study of a pedigree in which idiocy appears as a simple recessive, the heterozygotes developing senile dementia. From the statistical analysis of various families containing mental defectives, the conclusion is reached that in certain consanguineous families this condition is caused by single rare recessive genes, while in other families more complex relations obtain. Other conditions in which the inheritance element is analysed include mongolism, epilepsy and epiloia. It is suggested that sporadic cases of epiloia arise as mutations, and that the inheritance is dominant, although some cases are more in conformity with a recessive inheritance. A brief discussion of medicine and eugenics closes with the suggestion that in collecting pedigrees they may usefully be confined to only two generations, a suggestion which will not be generally accepted.

Vitamin Research in the U.S.S.R. A report of the first two years' work of the newly-formed Vitamin Laboratory of the Institute of Plant Industry appears as a collection of papers by Ivanov and his co-workers, forming Supplement 67 to the *Bulletin of Applied Botany, of Genetics and of Plant Breeding*, Leningrad, 1933 (in Russian, with short English summaries). Much of the laboratory work has been devoted to the discovery of a technique suitable for vitamin C investigations under Russian conditions. For example, the usual basal diets fed to guinea pigs in vitamin C investigations were discarded as a result of this work in favour of a diet of oats, autoclaved hay and autoclaved carrots. The symptoms of vitamin C deficiency were also studied in relation to the growth rates of the guinea pigs. Investigations have been carried out into the vitamin A and C content of varieties of cultivated plants, and into the effect on these of external conditions. It has been found, for example, that certain varieties of cabbages and potatoes have a lower vitamin C content under northern conditions. The effects of various processes normally used in the preparation and preservation of foods in Russia have also been the subject of experiments.

Pangolins and Aard-Varks. The American Museum Congo Expedition returned with ninety-five scaly ant-eaters or pangolins and thirteen aard-varks. Robert T. Hatt groups the former in a single genus *Manis*, within which he recognises as sub-genera the terrestrial and arboreal forms regarded by Pocock and others as representatives of full genera (*Bull. Amer. Mus. Nat. Hist.*, 66, 643; 1934). Specific characters are remarkably constant, and within the species of pangolins there appears to be no geographical differentiation. With the aard-varks the opposite holds true, although it may be that lack of material and insufficient diagnosis are partly responsible for the existence of sixteen races. Field notes on the habits of both groups of animals are included in the paper, and for the first time a well-marked sexual dichromatism has been noted in adult aard-varks.

Penguin Embryos. The *Terra Nova* Expedition of 1910 brought back three embryos of the emperor penguin and thirteen of the Adelie penguin. After several vicissitudes these have now been described by C. W. Parsons (British Antarctic *Terra Nova* Expedition 1910, Zoology, 4, No. 7, 1934). The unique emperor material showed no striking differences from other penguin embryos: the wing-bones, although distinctly betraying their ultimate form, lacked some of the adult fusion, and the feather papillæ closely resembled those of the gentos. In the Adelie embryos it was noted that the primitive slender condition of the tail was retained in development longer than in the fowl, and the author suggests that such persistence of a primitive character may be significant ancestrally.

The Freshwater Medusa, *Craspedacusta*. Dr. Emil Dejdar has recently published a complete account of the freshwater medusa *Craspedacusta sowerbii* (*Z. Morph. und Ökol. der Tiere*, Abt. A. der *Z. wissenschaft. Biol.*, 28, 5 (Schluss-) Heft., August 1934). The medusa was found in the *Victoria regia* tank, Regent's Park, London, in 1880, and the first notice of it was published in NATURE (22, 178, 218, 290; 1880) as *Limnocodium victoria*. The polyp (*Microhydra*) was first found in 1884 in the pool in the House for Medicinal and Economic Plants of the Royal Botanic Society of London (NATURE, 31; 1884) as "a hydroid form phase of *Limnocodium sowerbii*". Later on, both medusa and polyp were found in the open in their natural habitats, the species being of almost world-wide distribution. It is now fully established that *Microhydra ryderi* is the sessile stage of the medusa *Craspedacusta sowerbii*. In England, the only known locality for the medusa is the Exeter Ship Canal, where it was discovered by Mr. Vallentin, and is very abundant. Owing to the minute size of the hydroid phase (not more than 2 mm.) it is not often seen. It is frequently the case that medusæ of only one sex are found, having been produced from a polyp of the same sex. For this reason it has been difficult to obtain the fertilised eggs, but Payne (1926) found medusæ of both sexes and succeeded in growing the polyp from the egg. Dr. Dejdar has himself carried on important researches connected with this interesting animal, and now brings together the results of all workers. The anatomy, physiology, reproduction, ecology and systematic position are all fully discussed.

Bark Disease of Beech. The National Research Council of Canada has recently issued (June 1934) a special number of vol. 10 of the *Canadian Journal of Research*, devoted to the beech bark disease. The author of this memoir, Mr. J. Ehrlich, discusses the distribution of the disease in Europe and North America. Under North American conditions the malady begins with the infestation of the bark by

a minute and very common scale insect, *Cryptococcus fagi*, Baer. The insect feeds by inserting its stylet-like mouthparts into the bark and through to the underlying cortex and phloem. Saliva is injected into these punctures and protoplasmic contents withdrawn. When populous colonies of the insects feed in localised areas, whole clusters of parenchyma cells are killed. These clusters dry and shrink, leaving fissures which are readily invaded by the fungus *Nectria*. The actual specific identity of this organism presents great difficulties and has not so far been determined beyond the fact that it is a close relative of the common *N. coccinea*, Pers. A full illustrated account of the fungus is given together with a description of the structure and biology of the scale insect with which it is so intimately associated. While the *Cryptococcus* is the initial essential agent, it alone does not cause disease. Inoculations of clean intact bark failed to produce fungal infection, but similar inoculations on mechanically wounded and on *Cryptococcus*-infected bark produced infection. The disease can be controlled on ornamental trees by early eradication of the insect by means of insecticides. Control in forest stands should aim at removal of infected and dead timber. Attempts to control the scale insect by fungal and insect enemies is suggested, while the planting of beech on broad ridge-tops rather than steep slopes is advised. The culling of larger trees in an attempt to produce changes in the environment designed to restrict activity of the pathogens and the substitution of a younger, less susceptible stand are also recommended.

Leaf-Shape Inheritance in Cotton. In an extensive investigation of the inheritance of leaf-shape in Asiatic cottons, Dr. J. B. Hutchinson (*J. Genet.*, 28, No. 3) has reached some interesting conclusions. Using length-breadth indices for the lobing of the palmate cotton leaf, he finds that the leaf-shapes are controlled by a series of five multiple allelomorphs. A strain of *Gossypium arboreum* known as Burma Laciniated gave a number of bud mutations which bred true from seed and were of two types, with broad and intermediate lobes respectively. The rate of mutation was studied, and a fifth gene—recessive broad—was also used in the crosses. This leaf-shape locus shows linkage with brown tint, giving 30 per cent of crossing-over, and there is also linkage with seed weight and lint percentage, while corolla colour is independent. All varieties of *G. herbaceum* carry the gene for recessive broad lobes. Minor genes are also present affecting leaf size, lobe shape and rumpling, while lint characters are affected by a number of small genes scattered through the chromosomes. In a detailed discussion of the allelomorphic series of factors for leaf-shape, Dr. Hutchinson develops a hypothesis of the gene which combines the theory of stepallelomorphism with D. H. Thompson's side chain theory. This conception is then applied to the peculiar conditions of pericarp and cob colour in maize, to the anthocyanin series in cotton and the bar eye scute and reddish α series in *Drosophila*, as well as to the rogues in culinary peas. The investigations on multiple allelomorphs, on mutable genes and on the relations between mutation and crossing-over are all brought under one consistent view by this theory of gene architecture, which is essentially that of a continuous rod containing gene centres, to which are attached a series of episomes the changes of which constitute the passage from one allelomorph to another of the series, the episomes shifting their position in the gene in certain cases.

Brand Canker of the Rose. Brand canker is a rather serious disease of climbing roses. It was recognised in America in 1924, and its outbreaks were so severe that a detailed study of the malady was made by Dr. Cynthia Westcott ("Brand Canker of Rose, caused by *Coniothyrium Wernsdorfii*, Laubert". Cornell Univ. Agr. Exp. Sta. Memoir 153, pp. 1–39, Ithaca, N.Y., Feb. 1934). Brand canker has been confused with stem canker, which latter fungus is caused by *Coniothyrium fuckelii*, a fungus distinct from *C. wernsdorfii*. Symptoms of the brand canker are described in detail. The fungus enters its host through wounds, and infection usually occurs in late winter or early spring; there is no infection in summer. Control of the disease can only be obtained if infected stems are cut away; no benefit has been obtained by spraying or dusting in summer or winter. The disease is not severe if the bushes are left uncovered through the winter.

Periodicity of Earthquakes. The *Publications* of the Central International Seismological Bureau (Ser. A, Trav. Scien., Fasc., No. 10; 1934) contain two brief but interesting papers on this subject. Prof. V. Conrad (pp. 17–18) considers the frequency of earthquakes with deep foci during the years 1919–28. He finds that they are not subject to a diurnal period, and that there is no accumulation of earthquakes about the days of new or full moon. There are some grounds for believing in the existence of a semi-annual period, and this, in the author's opinion, points to rotation of the earth's pole as the cause of such variations. Father Luis Rodès has examined the influence of the moon on the frequency of 2,242 earthquakes recorded at the Observatory of the Ebro (Tortosa) during the years 1914–32 (pp. 87–90). He concludes that there is no definite period connected with the lunar day, but that the distance of the moon has a very marked effect, the number of shocks being 15 per cent higher about the time of perigee than about that of apogee.

The Polar Aurora. The August issue of the *Journal de Physique* contains an account by A. Dauvillier of the auroral work done during the Polar Year at a station at Scoresby Sound in north-east Greenland (70·5° N.; 22° W.). A large number of auroral formations were recorded, the day-to-day variations in intensity were recorded by estimation, and some work was done with a continuous photoelectric recorder. Spectroscopic observation of the 5577 line was often possible even when the sky was clouded. The author ascribes the variations in shape shown by the auroral curtains to turbulence in the ionosphere, probably of electromagnetic origin. He points out that the phosphorescent post-auroral clouds often have very high velocities of the order of a kilometre a second. The contraction of a generalised aurora into arcs and curtains he ascribes to an electrostatic ionic effect analogous to that employed in cathode ray oscillographs, and he points out that this explanation, applied to secondary electrons produced by very penetrating primaries, may account for the occasional appearance of auroral arcs in equatorial latitudes. The primary electrons of low energy can only reach the earth's atmosphere in high magnetic latitudes.

Toxic Effects of Ultra-Violet Radiation. Researches by Dr. Florence E. Meier, bearing on the toxic effects of ultra-violet rays, are discussed in a report by Science Service dated August 22, and are described in a publication of the Smithsonian Institution. The method used was to coat glass plates with a film of living single cell algæ, and project on it a band of ultra-violet radiation which had been separated out by means of a prism. Dr. Meier studied the killing effects of eight different wave-lengths in the ultra-violet range. She discovered that each had its own specific 'radiotoxic spectral emissivity', that is, the minimum quantity that would sooner or later result in death. Each wave-length also had a specific 'radio-toxic virulence' which measures the time required to produce the killing effect. The two qualities do not necessarily vary in the same way. A very small dose of some of the wave-lengths will kill the algæ but may take a very long time to do it. Radiations of other wave-lengths had to be applied in larger doses, but acted quickly when the necessary quantity was reached. To illustrate her point, Dr. Meier used the analogy of poison effects on human beings. Radium paint such as is applied to watch faces may kill in extremely small doses, but death may not ensue for years. A considerably larger quantity of rattlesnake venom is required to kill, but when that quantity is received death ensues in, at the most, a few hours. The wave-lengths studied by Dr. Meier are between 3022 A. and 2536 A.

Crystal Re-orientation of Cold Drawn Wires due to Re-heating. About a year ago, Alkins and Cartwright (*J. Inst. Metals*, 52, 221–239; 1933) showed that re-heating certain cold-drawn copper wires of high purity at a temperature of 130° C., that is, below the temperature at which annealing sets in, resulted in a small but definite increase of hardness. G. S. Farnham and H. O'Neill (*J. Inst. Metals*, 55, Advance Copy; 1934) have examined the change of X-ray structure resulting from this low temperature treatment, and have shown that in some silver-free copper wires, the general effect of the re-heating to 130° C. is to reduce the amount of [111] preferment and to cause an increase of [100] preferment. In silver-bearing wires where the low-temperature hardening is small, the changes of orientation, where they occur at all, are only slight, whence it would appear that an explanation of the mechanical effects in terms of such crystal re-orientation has been discovered.

Influence of Pickling on the Fatigue Strength of Duralumin. In order to assist in the detection of flaws due to manufacturing defects or cracking in service, aluminium alloy components are often etched in media which consist essentially of aqueous solutions of caustic soda. In order to determine the effect of this treatment on the fatigue strength, H. Sutton and W. J. Taylor (*J. Inst. Metals*, 55, Advance Copy; 1934) have carried out tests on duralumin which has received a normal pickling treatment, and shown that the fatigue limit may be reduced by as much as 31 per cent. This effect is clearly due to some surface condition and may be reduced either by the immersion of the part in boiling water, or by machining off a layer 0·0025 inches thick. In an attempt to devise a treatment which may be employed without the loss of fatigue strength, they have shown that the following procedure reduces the fatigue limit by 6 per cent only, and that subsequent immersion in boiling water lowers the loss of strength still further. The part is first immersed in boiling water, and transferred immediately to a bath containing four parts of 10 per cent sulphuric acid by volume to one part of hydrofluoric acid. A period of immersion of three minutes is used with constant agitation, after which the sample is rinsed in cold water and immersed for one minute in cold 50 per cent nitric acid. It is finally rinsed in cold water, washed in hot water and dried.

Chemical Linkage. Prof. R. F. Hunter and Dr. R. Samuel have contributed to the August issue of the *Journal of the Chemical Society* a critical review of theories of valency on the basis of wave-mechanics and band spectra. Their chief conclusions appear to be that whilst "Lowry's view that a semi-polar bond consists of a covalency and an electrovalency is not excluded by wave-mechanical principles in the present stage of knowledge," "it can be shown that a single electron does not possess bonding power, since the formation of the hydrogen molecule ion $[H_2]^+$ . . . depends essentially on the identity of the two positive nuclei and this case has therefore nothing to do with ordinary chemical linkage." The paper is too condensed to include a full demonstration of the basis for the assertions now made, and most of these should be regarded as merely tentative, since it is not yet clear that they will 'hold water' when subjected to a critical examination. Thus the equivalence of the two oxygens in the nitro-group is certainly not 'established' by the zero dipole moment of *p*-dinitrobenzene, since this equivalence may be merely statistical; and on the other hand, further evidence will be required before an unsymmetrical structure for the oxygen molecule need be admitted. Incidentally, the authors deny the existence of the BF_4^- and SiF_6^{--} ions, except as dipole aggregates, although in the latter case their conclusion is in flat contradiction to the generally accepted deductions from crystallographic evidence. The paper is therefore obviously provocative of discussion, but its influence on current theories of valency seems likely to be of a polishing, and not of a shattering, character.

Origin of the Galactic Rotation. The fact of the rotation of our galaxy is now comparatively well established, and is a property also possessed by other external systems. The origin of these rotations has been discussed by Dr. G. Strömberg (*Astrophys. J.*, 79, 460). It is traced back to the time when the systems were recently formed, and not very widely separated; close encounters of two systems producing the initial rotation through tidal forces. Large angular momenta would be produced in this way, but only small angular motions. During the process of contraction, however, the linear and angular velocities would increase, thus accounting for the rapid rotations now observed. In the case of our own galaxy, the encounter must have occurred before any very dense condensations had formed. The only individual dense objects which might have existed would be those which have developed into cluster-variables, long-period variables, and others of very high velocity. It is suggested that planetary systems like that of the sun might have been similarly formed, in which case they would probably be rather common in the galaxy, and not (as usually believed) very exceptional phenomena.

Reduction of Traffic Noise

ON September 10, in Section G (Engineering) of the British Association meeting at Aberdeen, Sir Henry Fowler presented, as chairman, the report of the Committee on Reduction of Noise, and thus introduced a series of papers on the subject. This Committee has analysed a large number of letters from members of the public concerning the noises which cause them most discomfort and inconvenience, and has reached the conclusion that the sources which cause most annoyance are, in turn, inadequately silenced motor-bicycles and 'sports'-type motor-cars, motor-horns, other road transport noises and aircraft. No other cause produces half the complaint levelled against the latter source. Realising that the Air Ministry is doing everything possible to reduce aircraft noise, the Committee has devoted its attention first to the exhaust noises of motor-bicycles and sports-cars and, with the help of a donation of £50 from Lord Wakefield, an investigation of silencers was carried out at University College, Southampton. In order to assist in the establishment of an authority to which types of motor-vehicle could be submitted for test of approved silence, the Committee arranged for a critical review of the methods available for measuring noise, particularly noises of a given type, such as exhaust noises. Arrangements were also made for a firm manufacturing motor-horns to give a paper examining characteristics which render a signal effective as well as those which cause it to be offensive.

Dr. E. O. Turner, of Messrs. Joseph Lucas, Ltd., described and demonstrated various horns at the meeting and at open-air tests. He considers that expedients suitable for further consideration are that horns should give a strictly periodic note without appreciable delay when operated; that the note should have a fundamental of low pitch with one or more strong overtones, the highest not exceeding 3,000 cycles per second, the loudness not exceeding a prescribed figure; that auxiliary horns of higher pitch and greater loudness might be fitted to motor-vehicles, but for country use only, and that single staccato signals should be employed wherever possible instead of sustained notes.

Wing Commander Cave-Brown-Cave outlined the experiments which have been carried out at Southampton, in attacking the problem of silencing the exhausts of motor-bicycles. He reviewed recent work on exhaust noise, and ascertained with the assistance of the Motor Cycle Manufacturers and Traders Union the maximum size acceptable for silencers intended for motor-cycles. After experiments in which the back pressure on the engine and the power developed were measured, he has evolved silencers for representative 2-stroke and 4-stroke machines which gave adequate silencing without obstructing the flow of exhaust gases, and thus without causing loss of power. These silencers consist essentially of two lengths of absorption silencer in series with two small expansion chambers, the whole being compactly contrived in an outer casing of convenient size. The absorption silencers consist of a perforated pipe surrounded with one of larger diameter. In some cases, the interspace is packed with absorbing material such as glass silk, and in others the packing is omitted and the perforations are in the form of lipped holes resembling those used in nutmeg graters.

Demonstrations of the effectiveness of the silencers were given at the meeting and on a hill near the Brig o' Dee, where 2-stroke and 4-stroke motor-cycles fitted with various standard and "B.A." silencers were demonstrated.

Dr. A. H. Davis, of the National Physical Laboratory, in discussing noise measurement from the point of view of tests of approved silence, dealt particularly with the accuracy and validity of various methods. Aural methods of loudness measurements necessitate the averaging of the results of several observers in order to get a typical result with the precision that is likely to be called for in testing machines to specification. Moreover, aural results will always be open to suspicion of personal bias. Objective instruments can be constructed, however, which, in suitable cases, will give a meter reading corresponding to the average aural judgment. Such instruments are not wholly rigorous in their theoretical foundations, but the more serious difficulties are known and appear to have been overcome. In fact, objective meters have been used successfully for measuring moderate and loud sounds of varied character, and have even proved more reliable than individual hearers in assessing average judgments as to relative loudness. The demands upon the objective meter are, however, minimised if the sounds concerned are of similar character and of the same order of loudness, so that properly designed meters may certainly be expected to indicate whether or not a device of a given type (say, exhaust or motor-horn) is louder than a standard device of the same kind. At present, however, preliminary test of any particular meter is desirable upon the type of noise concerned.

Dr. Davis later demonstrated, at the motor-cycle silencer trials, a noise-measuring instrument of his own design which is in use at the National Physical Laboratory; this gave indications in the trial which were believed to be in agreement with the general impressions of the order of loudness of the silencers concerned. The loudness at the roadside, under the conditions of the test, of the unsilenced 4-stroke motor-cycle, was about 106 phon, and this was reduced on an average to 93 and 87 phon respectively when standard and "B.A." silencers were fitted; a rather larger "B.A." silencer gave further reduction, to 84 phon. Conditions (speed, throttle-opening, etc.) were maintained as constant as possible during the tests, but closer control would be necessary to differentiate between exhaust systems differing in loudness by only one or two phon. In the case of the 2-stroke motor-cycle, the loudness unsilenced was about 100 phon, a level which was reduced to 82 phon and 75 phon respectively when standard and "B.A." silencers were fitted. An improved (1934) Standard silencer was in this case almost indistinguishable in loudness from the "B.A." silencer.

It may perhaps be now inferred that appreciable silencing of motor-cycles can be achieved. It also appears that if manufacturers or appropriate authorities desire to fix limits to the permitted noisiness of machines or of motor-horns, some standardisation would undoubtedly be necessary of the conditions and surroundings under which the machines or horns are to be tested, but that it is now within the scope of well-designed physical noise meters to make the necessary measurements. A. H. D.

Astrophysics at the Royal College of Science*

TRIBUTE TO PROF. A. FOWLER

FOR more than fifty years Prof. Fowler has been associated with the work of this College. For the greater part of that time he has been one of its leading figures; and now the time has come for that long association to cease. On such occasions as this it is customary—and it is well—to practise some dissimulation. If we were to express the feelings that lie nearest our hearts, we should not feast, but fast:

"Make dust our paper, and with rainy eyes
Write sorrow on the bosom of the Earth."

But the age of realism in such things has yet to come. If the future is dark, we look towards the past and draw comfort from the thought that much that has been done survives and will survive in the days to come. In the career of Prof. Fowler there is special warrant for that reflection. When we look back at the long history of things of great value done supremely well, we are not only assured of their permanence; we are also held by the romance of their achievement.

We of this generation are inclined to look upon the period about the year 1895 as marking the renaissance of physical science from a state of stagnation—a state in which, as it has been said, it seemed that nothing remained to be done but to add a few more decimal places to the values of well-determined constants. That is not altogether a true picture. In the mind of one man, at least, the morning twilight of the new day shed its light long before the sun rose. At the Normal School of Science, which we are proud to claim as our ancestor, Norman Lockyer was making those researches into spectrum analysis and building those seemingly fantastic theories which to his contemporaries were either stumbling-blocks or foolishness, according to their nature, but which we recognise as the authentic herald of the physics of to-day. Lockyer could not convince the mature, but he could inspire the young; and in 1882 there came to his lectures a very young student, with more than ordinary ability, with all the enthusiasm of youth, and with the potentialities of a boundless loyalty waiting to be claimed. The sequel was inevitable. Lockyer was not only a pioneer in science, he was also an organiser of the first order; and to that genius which gave the world its foremost scientific journal came its other great inspiration. In 1886, Alfred Fowler became computer to Prof. Lockyer.

It was my privilege a few years ago to be given access to Lockyer's papers. The name of Fowler does not often appear, but when it does the references are significant. "My excellent assistant Mr. Fowler." "Mr. Fowler did his eclipse work admirably." Whenever a piece of research depended on a crucial observation, that observation was invariably Mr. Fowler's. In scanning the records one became conscious of a dim Presence haunting the background, always ready to interpose at the difficult minute—the sort of figure of which legends are made, like some shadowy Siegfried supporting the arms of the visible hero.

In the year 1901, Lockyer retired from the Royal College of Science, taking his laboratory equipment with him into the Solar Physics Observatory, of which he retained the directorship, and Mr. Fowler was left in charge of what astrophysics remained in the College. To one who knows the Astrophysics Department only as it is to-day, its beginning at that time is scarcely credible. Mr. Fowler's laboratory was a table in a frequently used lecture theatre, in a corner of which a dark room had somehow to be improvised. For apparatus he had one small spectrograph, of a type which we should now consider suitable for a promising child's stocking at Christmas; and for encouragement the collected indifference of most of those who might have been concerned. In such circumstances was begun that remarkable series of researches which lie at the basis of modern physical astronomy—the identification of the bands in the spectra of red stars; the detection of magnesium hydride and other compounds in sunspots; the solution of the problem of comet-tail spectra; the laboratory production of 'cosmic hydrogen'; and the many contributions to the experimental foundation of spectroscopy which have made our Astrophysics Department a goal of pilgrimage from all the continents of the earth. All the world knows these things; but he only knows the difficulties and the disappointments that beset their accomplishment.

My own acquaintance with Prof. Fowler began in the early days of the War, when his supremacy in all branches of spectroscopy was already established, and the new Bohr theory was making it manifest to all. To me, as a student, he was a great man by natural right. He belonged to the hierarchy of professors, who had not experienced the difficulties of us lesser minds, but had always lived aloft in inaccessible greatness. You can imagine my surprise when he came into the laboratory and joined in the elementary instruction, turning globes and adjusting spectroscopes with more skill and almost as much assurance as a first-year demonstrator. He didn't shirk questions: he invited them; and the familiarity with the workings of Nature which he showed led us to sympathise with the error of the young lady who construed the arrow with the word "Wind" on the driving-clock of the telescope as his instruction to the wind to blow that way.

One of his rare errors of judgment occurred just after the War, when he asked Prof. Callendar for my services as demonstrator. There was no competition, and the request was granted. Another junior member of the staff said to me: "Why are you going into astrophysics? That's a side-line. You would do better to stick to general physics, and keep out of that narrow groove." But for my part I was pleased. The subject certainly had attractions, but to me it was not so much astrophysics as Fowler's Department that I was entering; and I soon found that, so far from entering a narrow groove, I was receiving a more than liberal education. We were a centre to which men of all types converged —astronomers with impossible theories to be made plausible; archæologists with specimens to be tested to discover whether the Sumerians could make bronze; nurses asking if their foods contained enough vitamins to build bonny babies; psychologists looking for differences between the spectra of human

* From a speech by Dr. H. Dingle at a complimentary dinner to Prof. A. Fowler, at the Imperial College Union, on Oct. 9 (see NATURE, Oct. 13, p. 562).

and animal souls: we were an encyclopædia for poets searching for spectroscopic metaphors; a hospital for ideas battered by the shocks of criticism; a home for the consolation of lost causes and the triumph of successful ones: people of all trades, professions, races, nationalities, sexes, ages, religions—great men, small men, lean men, brawny men, brown men, black men, grey men, tawny men, grave old plodders, gay young friskers—all came for advice to this narrow specialist, and went away, if not always satisfied, at least convinced that nothing further could be done along that line.

All this is now ended, but we have one consolation, and a great one. When Persephone was taken by Pluto from the fields of Enna into the shades below, she was permitted to return once a year for the comfort of those who were left behind. Prof. Fowler is not going into the shades: he is leaving the visible spectrum, but there is a whole octave of ultra-violet to be traversed before the vacuum region is reached. And whatever god presides over the land in which he chooses to dwell, he goes on the condition that, not merely once a year, but whenever instinct tells him that he is needed, he is to be allowed to revisit the glimpses of the arc and the spark and the vacuum tube; and I for one shall listen daily for the familiar footstep. When it comes a drawer will be opened, and out will come the problems and the difficulties that have been put aside to await the coming of the master.

Fluorescence Microscopy and its Application to the Identification of Fibres

One of the most recent and interesting applications of ultra-violet light as a testing method is its use as an aid to microscopical work. Since it is well known that structures visible to the naked eye show distinguishing features in ultra-violet light which are invisible in ordinary light, it is not unnatural that the application to microscopic structures of the same principle should have been attempted. As already indicated[1], this method has met with considerable success, notably in the examination of sections of botanical specimens such as seeds, tissues, etc., the best results being obtained in cases where the individual details of the structure fluoresce differently. Starch and fatty matters, for example, fluoresce vividly and stand out in sharp contrast, and a notable case is that of cacao, in which the shell tissues and mucilage cells may be distinguished in this way.

The method has now been carried a stage further by the use of fluorescent materials as stains, and this has opened up many promising lines of advance in microscopical technique. It is obvious that if the dyes used for selective staining in ordinary microscopical work are supplemented by substances which cause a particular detail of the structure to fluoresce with a specific colour in ultra-violet light, then many strings will be added to the bow of the practical microscopist. Fortunately a large number of such substances (usually dyes) exist, and only await investigation.

The apparatus required for this work is by no means elaborate. A good microscope and a source of ultra-violet light are of course essential, and in connexion with the latter there seem to be differences of opinion among various workers as to which type gives the best results. All would probably agree, however, that a brilliant point source is desirable, so that the mercury vapour lamp in the form most familiar to workers in Great Britain is by no means the ideal. Successful results have, however, been obtained with arcs struck between iron, cadmium, magnesium-carbon and nickel-carbon electrodes.

The lens system on the arc side should be made of quartz on account of the absorbing powers of ordinary glass for ultra-violet light. This applies to the converging lens and condenser used to concentrate the light on the microscope mirror, and in addition it is desirable to insert filters to remove visible and infra-red rays, so that the radiation finally obtained covers the range 3,000–4,000 $m\mu$. Numerous commercial filters are available for the former purpose, and for the latter a cell containing a solution of copper sulphate is very convenient. Since the microscope is used only for the observation of effects produced by visible light, ordinary glass lenses may be used, and if the fluorescence is sufficiently bright, these are satisfactory even for colour photography.

Useful adjuncts in this work are devices for dark-ground and surface illumination. The Lieberkuhn mirror and other lens systems used for the latter purpose give very striking results which are quite different from those obtained by transmitted light; the self-luminosity of fluorescent structures also enables vivid effects to be obtained with dark-ground illumination. In some cases, it is an advantage to bed the specimen in a mounting medium, and the selection of the medium should be then governed by the nature of the specimen. Thus both Canada balsam and paraffin wax themselves fluoresce, but whilst in some cases the emission of light masks the fluorescence of the structure, in others it may be used to throw dark structures into relief. A speck of quinine placed on the slide is a great aid in focusing, as it is highly fluorescent.

Even under the above conditions, a certain amount of ultra-violet light may still reach the eye, and it is therefore advisable for prolonged work to wear protecting goggles in order to avoid the possibility of conjunctivitis. Special cover-slips which are opaque to ultra-violet light are an additional precaution and serve the further purpose of eliminating any fluorescence produced by the action of the rays on the lens system. For work with transmitted light, a quartz prism or a silver reflector is used in place of the microscope mirror, and the slide must, of course, be made of quartz; glycerol should replace cedar wood oil for 'oil' immersion lenses.

Some of the most interesting advances in this work have been made in connexion with fibre analysis, and in particular with that branch of the subject which is the concern of the cellulose industries. A number of ordinary stains are already in continual use in this connexion, but they suffer from several defects, notably that they are difficult to prepare in a sensitive form, and that their applications are limited. F. Noss and H. Sadler[2], however, have examined the suitability of a large number of dyes from the point of view of fluorescence microscopy, and find that in particular, a 0·05 per cent solution of rhodamine-6 *G-D* has useful properties. Thus, fibres prepared by the sulphite process appear yellow, whilst sulphate pulps give an orange-red colour; if the fibres have not been bleached the colours assume a brown tinge. Since the vivid blue fluorescence of unstained, unbleached wood fibres is a well-known phenomenon,

it is therefore possible first to determine the amount of this material present and then, by staining, to ascertain by what process it has been prepared.

This work has more recently been taken up and extended in a series of publications by B. Schulze and E. Göthel[3]. They also examined a large number of dyes and confirm the suitability of rhodamine and eosin, and in addition, recommend sulphorhodamine-*G* and certain of the flavophosphines; the former may be used to distinguish unbleached soda pulp from bleached soda and sulphite pulps, in the absence of unbleached sulphite pulp. Brilliant dianil green was also found to be a useful aid to the distinction of summer and spring woods, with which it gives a blue and yellow colour, respectively. Adansonia (light blue) could be differentiated from manilla and jute, and diagnostic details of other unusual fibres such as Gampi, Mitsumata and Kodzu were also obtained; in some cases these methods have been developed quantitatively. A word of caution seems desirable in connexion with the use of rhodamine-6-*G* for fluorescence experiments, as the writer has found that dyes from different sources sold under this name may give entirely different effects; this indeed may explain the failure of Schulze and Göthel to confirm some of the results of Noss and Sadler where this dye has been involved.

Reference should also be made to the work of E. Grünsteidl[4] in which similar principles are applied to textile fibres. The primary fluorescence of such fibres, that is, the fluorescence obtained in the unstained state, is itself of value for diagnostic purposes, raw cotton being bright blue (dull grey if mercerised), whilst various silks (real and 'artificial') may be differentiated if examined under controlled conditions. The use of dyes and stains, however, and in particular of quinosol followed by alkali, has proved an additional aid; for example, linen then appears yellow and cotton violet. Similarly A. Segitz[5] records the use of extract of spruce bark for the differentiation of materials of the "Cellophane" type.

These examples are necessarily restricted in use and as yet incompletely investigated, but they at least serve to illustrate the possibilities awaiting investigation in this field. J. G.

[1] NATURE, **133**, 124, Jan. 27, 1934.
[2] *Pap. Fabrikant*, **31**, 413; 1933. Korn, *ibid.*, **32**, 181; 1934.
[3] *ibid.*, **32**, 110; 1934. *Zellstoff Pap.*, **14**, 93; 1934. *Woch. Pap.*, No. 7; 1934.
[4] *Faserforschung*, **10**, 215; 1933. *Rayon and Melliand Text. Month.*, **15**, 88, 93; 1934.
[5] *Pap. Fabrikant*, **28**, 206; 1930.

Microplankton and Hydrography of the Great Barrier Reef*

MISS S. M. MARSHALL, in her contribution to the Scientific Reports of the Great Barrier Reef Expedition, describes the production of microplankton in the Great Barrier Reef throughout the year. This is the first time that an opportunity has occurred of obtaining continuous observations in one place for so long a time in these regions. The results of the work carried on in the lagoon of the Great Barrier Reef enables a comparison to be made between the conditions in the tropics and those in temperate waters. The water samples used were from various depths, forming part of the routine work at the plankton and hydrographic stations taken by the Nansen-Petterson water bottle. Outside samples were also taken with a glass sample bottle. The material was centrifuged and counted (100–200 c.c. of each sample). Most of it was examined when fresh, thus allowing the small naked dinoflagellates and coccolithophores to be included; the remainder was preserved in strong Fleming solution.

The organisms were grouped so far as possible in their genera. Neritic forms are predominant as was to be expected, especially among the diatoms, which were the most important group. Dinoflagellates and coccolithophores occurred in fair numbers, the latter restricted to water of high salinity. Pennate diatoms were unexpectedly numerous inshore, most of them being bottom forms stirred up from below.

The chief feature of the Great Barrier Reef plankton is that there is no special seasonal maximum and minimum; it is maintained at much the same level throughout the year. This is strikingly different from the conditions in temperate waters where one or two maxima constantly occur, the phytoplankton maximum being followed by a zooplankton maximum. Miss Marshall finds no real seasonal change in the composition of the diatom flora. Large increases sometimes occur, but not regularly. In the lagoon the wind keeps the water thoroughly mixed from top to bottom. The nutrient salts estimated were present only in very small quantities throughout the year and no relation was found between them and the diatom or dinoflagellate abundance. The type of plankton production found, the numbers low and varying little during the year, depends largely on physical conditions.

Trichodesmium occurs in large patches at irregular intervals, being most abundant in the calmer months from October to February. On August 22–25 large patches drifted on to the reef causing great distress to the fishes in the moats, and eventually decayed along the shore. In Mr. Orr's report (No. 4*a*), it is stated that at this time, because of *Trichodesmium*, although the water had been supersaturated with oxygen just when the tide left the reef flat, it was completely denuded of oxygen before the tide re-entered. Only pools in which the blue-green alga was deposited in quantity and decomposing showed this absence of oxygen. On no other occasion was a value below saturation with respect to oxygen found during the day on the flat.

The changes in temperature, salinity, oxygen and *p*H value among the coral reefs are specially described and vary enormously, both daily and according to season. These changes may have an important effect on the reef organisms. Tidal and diurnal changes are on the whole more important than seasonal changes. The greatest differences occurred in coral pools isolated at low tide either during the night or during the day, the water being usually supersaturated with oxygen during the day and undersaturated at night.

In the mangrove swamps (No. 4*c*) the diurnal and seasonal changes are greatest at spring tides and are greater in summer than in winter. There are diurnal fluctuations in temperature, salinity, *p*H value and oxygen content in the mangrove swamps on Low Isles reef flat and usually a night fall and a day rise in temperature: salinity rises at low tide whilst *p*H value and oxygen saturation fall.

*British Museum (Natural History). Great Barrier Reef Expedition 1928–29. Scientific Reports. Vol. 2. No. 4. (*a*) "Variation in some Chemical Conditions on and near Low Isles Reef". (*b*) "The Temperature of the Waters in the Anchorage, Low Isles". (*c*) "Physical and Chemical Conditions in the Mangrove Swamps". By A. P. Orr and F. S. Moorhouse. No. 5. "The Production of Microplankton in the Great Barrier Reef Region". By Sheina M. Marshall. 1933.

University and Educational Intelligence

CAMBRIDGE.—The Gedge Prize for 1934 has been awarded to J. S. Turner, of Selwyn College.

Two lectures will be delivered by Prof. J. Schouten of the Technical High School, Delft, on "Projective Relativity". They will be delivered at 5.30 on October 23, and 4.30 on October 24 in St. John's College.

In connexion with the visit of His Majesty the King to open the new Library on October 22, it is proposed to confer the honorary degree of Sc.D. on Prof. L. J. Henderson, professor of biological chemistry at Harvard University and upon Dr. Karl Landsteiner, member of the Rockefeller Institute for Medical Research.

Dr. F. Kidd, St. John's College, has been appointed superintendent of the Low Temperature Research Station in succession to the late Sir William Hardy.

At Trinity College, M. Black, University demonstrator in geology, has been elected to a fellowship.

OXFORD.—In his oration delivered on the termination of his second year of office, the Vice-Chancellor dealt with several matters of scientific interest. After noticing the completion of the extension of the Radcliffe Science Library, which is to be opened for use on November 3 by the Princess Royal, he reported the successful setting up of the new solar telescope, with its accessory apparatus, under the skilful direction of the Savilian professor. Permission, subject to certain conditions, has been granted to the Radcliffe Trustees to establish an observatory in South Africa. Future developments of the means for scientific study will be carried out as soon as the necessary funds are forthcoming. Among these are the extension of the Lewis Evans collection into a museum of the history of science, the further endowment of the Department of Anthropology, an addition to the staff of the Hope professor of zoology, and further provision for the teaching of embryology and neurology. Several of these are regarded as urgent, but, for the time being, impracticable.

WALES.—It was announced at a meeting of the Court of Governors of University College, Cardiff, that the college has received a gift of £23,000 "from a generous donor and old friend of the college". The number of students in residence during the current session is 1,347. The figure shows an increase of 24, as compared with last year, in spite of new restrictions on the entry of medical students, and those in receipt of Board of Education grants.

On October 12, Sir William James Thomas officially opened the new laboratories of materia medica and pharmacology in the Department of Preventive Medicine at the Welsh National School of Medicine.

THE following awards of the Institution of Naval Architects have recently been made: Vickers Armstrong scholarship in naval architecture (1934) of the value of £150 a year for four years at the University of Glasgow to Mr. Gordon S. Milne, of Messrs. Hall Russell and Co., Glasgow; Duke of Northumberland prize (in connexion with the 1934 examinations for National (Higher) Certificates in naval architecture) to Mr. William P. Walker, of the Royal Technical College, Glasgow.

Science News a Century Ago

Diseases in Potatoes

In the early part of 1834, the Highland Society of Scotland (now the Highland and Agricultural Society) offered a premium of ten sovereigns "for the best essay on the nature and causes of the injury or disease of the Potato and on the best means of preventing or palliating it in future. . . . The attention of the writer is especially directed to the probable existence of insects in the sets or tubers, and if such have been detected, he is required to give a description of them and if possible, to transmit with his Essay, specimens of the insects". The essays had to be submitted before October 20, 1834, and some twenty competitors took part. The premium was offered because of the failure of the potato crop in Great Britain in the previous year. Various organisations interested themselves in the problem—notably the Highland Society and the Royal Dublin Society. The general conclusion arrived at was that the failure was due to the drought of the summer of 1833, as a consequence of which the crop was harvested very early, and in an immature condition. It is interesting to note that it was agreed that "the plant itself does not appear to have become materially deteriorated by having been so long in cultivation".

The North-West Passage

In 1833, Admiral Sir George Back (1796–1878), then holding the rank of commander, was sent out with an expedition to obtain information about Capt. John Ross, who had been in the north since 1829. On October 23, 1834, the *Times* said that "Letters from Captain Back were received yesterday morning at the office of the Royal Geographical Society the latest date being the 29th of April last, when the intelligence had just reached him of Captain Ross's return". Their contents were of a mixed character. He and his party were all well with the exception of Augustus, the Eskimo interpreter who had accompanied Sir John Franklin in both his journeys, but who had died on his way to join Back's party. The expedition had experienced a most distressing winter and many of the unhappy natives had fallen victims to famine in situations the most revolting to human nature. In a private letter, Back said, "My day is chiefly spent thus—before breakfast I read a portion of Scripture, and afterwards attend to my observations, study, draw (I have plenty of pencil sketches), work up my survey, take notes on Aurora, etc. At the same time I keep my eye upon whatever duty is going on, have an evening school twice a week, and read the service in French and English every Sunday. My guitar is cracked and jars abominably, but you will not be surprised at this when I add that I have been obliged to grease my hands daily to prevent their cracking also, for such is the dryness of the atmosphere that nothing can stand it." Back's expedition was notable for the discovery of the Great Fish River.

Hancock's Steam Carriages

Of the various projectors of steam road carriages, none came nearer commercial success than Walter Hancock (1799–1852). On October 25, 1834, the *Mechanics' Magazine* published a communication from him entitled, "A Statement of the Performances of the Autopsy and Era on the Road between London

and Paddington, from the 18th August to the 11th October, 1834", in which he gave some particulars of the defects which had occurred in those steam vehicles, and the difficulties which had arisen from the bad state of the roads. "I have up to this time," he said, "carried nearly 4,000 passengers in perfect safety, and I am happy to say that the Johus of the road get more friendly and reconciled to us; and as it is my intention to employ steady coach drivers as steersmen the sooner this feeling is fully developed the better. Why should there be the least ill-will? What difference can it make, whether they drive horses or

" 'Sweep o'er the hills in the glory of steam'."

Societies and Academies

PARIS

Academy of Sciences, September 3 (*C.R.*, 199, 545–560). K. ZAREMBA: An extension of the idea of the differential equation. ROLF NEVANLINNA: A general principle of analysis. ED. LE DANOIS and L. BEAUGÉ: The relief of the edge of the continental plateau to the west of the entrance to the English Channel. A chart of the western entrance to the Channel is reproduced showing the extreme complexity of the relief of the continental edge. The hydrographical work upon which this chart is based was carried out with the Marti self-recording sounding apparatus, supplemented and confirmed by the Langevin-Florisson apparatus. QUIRINO MAJORANA: A new interference apparatus. This consists of a slit and a prism of very small angle, about 1°: the author calls it the monoprism and outlines some of its applications. JEAN RATELADE: The rhythmical precipitation of silver chromate in "Cellophane". CHARLES COURTOT and JOSEPH FRENKIEL: The phenyltolyl- and ditolylsulphinones.

September 10 (*C.R.*, 199, 561–592). CHARLES RICHET: Anaphylaxy in therapeutics. Medical and therapeutic treatments ought to be brought into relation with toxic actions of which they are only the first stage. Certain observations have proved that the repetition of a dose originally inactive has a therapeutic effect. HENRI ADAD: Researches on surfaces several times encircled. CHARLES PLATRIER: The small elliptical vibratory movements of the most general homogeneous material medium. M. DODERO: The preparation of cerium silicide and lanthanum silicide by igneous electrolysis. The cerium silicide $CeSi_2$ can be obtained by the electrolysis of small quantities of cerium oxide in baths of calcium silicate, at relatively low temperatures (1,000° C.). Substitution of the cerium oxide by lanthanum oxide gives the silicide $LaSi_2$, not hitherto described. MME. ANNE JOFFÉ and A. JOFFÉ: The spectral distribution of the photoelectric effect in cuprous oxide. From the observations of the author and of other workers it is concluded that the photoelectric effect of cuprous oxide or of selenium is due to the reduction of resistance produced by the illumination of the thin arresting layer. E. DUCHEMIN: The magnetic susceptibility of some hydrates of magnesium sulphate and of some salts of the magnesium series. Measurements of magnetic susceptibility lead to the conclusion that the salts $MgSO_4$, H_2O and $MgSO_4$, K_2SO_4 are unstable complex compounds in the solid state. The first of these remains a complex compound on hydration but the latter is converted by addition of water to molecular combination. M. BOBTELSKY and B. KIRSON: Reaction of complex salts of copper on the decomposition of hydrogen peroxide. ED. CHAUVENET and MLLE. J. BOULANGER: The combinations of zirconyl iodide and the alkaline iodides. From the results of a thermochemical study the existence of the following compounds is deduced, $ZrOI_2.KI$, $2ZrOI_2.RbI$, $2ZrOI_2.CsI$, and $2ZrOI_2.NH_4I$. There was no evidence of the formation of similar compounds with lithium and sodium iodides. PAUL BASTIEN: The properties of sublimed calcium. A comparison of the properties of resublimed calcium (99·3 per cent calcium) with two commercial specimens (98·6 and 93 per cent). ROBERT DELAVAULT: The mechanism of oxidation of alloys of magnesium and of calcium at a high temperature. PIERRE LAURENT: The use of the specific inductive capacity in the study of reactions in organic solution. ROGER PERROT: The action of nitrosyl chloride on some aromatic nitriles. RAYMOND-HAMET and L. MILLAT: A new alkaloid from *Mitragyna*, mitrinermine. The bark from *Mitragyna inermis* is used by certain tribes in tropical Africa as a febrifuge. A crystalline alkaloid has been extracted from this bark, of the composition $C_{22}H_{28}N_2O_4$. P. ZÉPHIROFF and MME. N. DOBROVOLSKAIA-ZAVADSKAIA: A liposoluble œstrogenic substance isolated from spontaneous mammary tumours of mice.

CAPE TOWN

Royal Society of South Africa, June 20. A. OGG, E. N. GRINDLEY and B. GOTSMAN: Diurnal and secular variations of the earth's magnetic field at Cape Town. In a former communication (*Min. Proc.*, October 18, 1933), the monthly means of the declination and the secular variation (+ 4·2′) for August 1923–33 were given. The mean variation from seven such determinations extending to February 1933–34 gives for all days of the month a value of + 3·8′ (that is, to the east). This determination that the secular change of declination in this latitude is of the order of + 4′ is of importance since magnetic tables gives the value + 10′ for the epoch 1925. A Fourier analysis of the declination referred to meridian 18° 30′ E. gives a good agreement between corresponding months of the year. From the above data the secular variation of the horizontal intensity is − 97 gamma, probably the largest secular variation at any point on the earth's surface between the latitudes 60° N. and 60° S. R. S. ADAMSON: The vegetation and flora of Robben Island. I. DONEN: Studies in deciduous fruit: the effect of time of picking on the keeping quality of plums, with especial reference to the internal browning of the Kelsey plum. Plums were chosen from four orchards differing in soil, climate and cultural treatment, kept at 34°–36° F. for 30 days and at room temperature for four or twelve days, and percentage breakdown recorded. Kelsey plums in store exhibited two types of breakdown: internal and invasive browning. The extent of browning is associated with the amount of skin colour of the plum on picking. For export, they should be picked with 5–8 per cent colour and should not be kept in store for periods much longer than 30 days.

GENEVA

Society of Physics and Natural History, June 21. R. WAVRE: Fourier's integrals and the representation of certain multiform harmonic functions. R. MOTTIER:

The oxidation of cod liver oil and a rapid method for determining the antioxygen action of various compounds. A. LIENGME and NICOLE: A new microorganism pathogenic to man: *Bacillus cysticus fragilis*. The authors have isolated from the urine of a man suffering from slight cystitis a new microorganism distinguished by various characters from those at present known. A. LIENGME and MLLE. PIQUET: Study on the interferometry of Hirsch. Researches on the presence of a non-specific power of concentration. Researches on the presence of a non-specific power of concentration of the opzims (non-specific value of Durupt) (1). By exhaustion of the power of fermentation of the serum. A first series of experiments tends to show that there does not exist a non-specific power of concentration of the serum by the opzim. A. LIENGME and GOUDET: The proportion of the blood groups at Geneva. Statistics based on 1,000 cases. Group *O*, 40·2 per cent; group *A*, 48·9 per cent; group *B*, 7·9 per cent; group *AB*, 3 per cent. The formula of the blood groups of the Geneva population is nearer to that of France, Belgium and especially Portugal than to that of Germany and even German Switzerland. F. WYSS-CHODAT: (1) Studies on the bacteriophage. Is the bacteriophage of Hérelle a living organism? Result of the study of the flocculation of the bacteriophage and of its sensitivity to some volatile antiseptic solvents. (2) Concerning the food value of milk. J. BUFFLE: A new character of glacier-fed rivers based on the periodicity of the proportion of dissolved matter in the waters of these rivers. Remarks on the proportions of dissolved matter in the waters of the Arve in 1933. CH. E. GUYE: Some properties of the layers of molecular dipoles.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 7). B. HOSTINSKY: A functional equation considered by Chapman and by Kolmogoroff. R. KUZMIN: Roots of the function $\zeta(s)$ of Riemann. N. KOSHLIAKOV: Some integral representations of the square of Riemann's function. V. LEVSHIN: On the connexion between the absorption and luminescence spectra in concentrated solutions of colouring matters. R. JAANUS and V. DROZDZHINA: The state of the cerium atom inside the metallic lattice. The authors suggest that in cerium metal there exist either one or three 'free' electrons per atom. M. KATZNELSON and I. KNUNIANC: β-quinolylazo-$\alpha\alpha_1$-diaminopyridine and its derivatives. V. SADIKOV and D. MALIUGA: Autoclave splitting of blood albumin with 2 per cent phosphoric acid (1). Isolation of cycloleucyl-leucyproline from ether extract. It has been determined by analyses of the copper salts that the cyclopeptide $C_{17}H_{29}N_3O_3$ gives on splitting two parts of leucine and one part of proline and is therefore a cyclopeptide cycloleucyl-leucyproline. Its structure is given. P. LEBEDEV: Geochemistry of manganese in Western Siberia. The scheme of migration of manganese may be represented as follows. Manganese in pyroxenes and ore formations: gabbro → bivalent manganese in magnetites of iron ore bodies → manganese in the zones of segregation. The last stage of the possible history of manganese compounds seems to be connected with the genesis of quartzite-breccia type of manganese ores. V. KOLESNIKOV: On the Sarmatian fauna in Bulgaria. A. GUBIN: The distribution of bee-keeping in the U.S.S.R. as related to climate. The regions where bee-keeping thrives have 500 mm. or more of annual precipitation, though bee-keeping is practised also in areas with 300–500 mm. precipitation. The northern limit depends on the length of winter, and there are scarcely any bees where rivers remain frozen for more than 180 days a year. G. LINDBERG: Description of a new genus and species *Gobiodonella macrops* (Gobiidæ, Pisces) from Misaki, Japan.

ROME

Royal National Academy of the Lincei, May 20. G. A. CROCCO: The 'focus' of a biplane. A method is given for determining the focus of a biplane, this being defined as the point of application of the resultant of the increments of the aerodynamic forces on the two wings. A. DI LEGGE: Observations of the horizontal diameter of the sun at the Royal Observatory at Campidoglio during 1901–10. The mean of the values obtained by three observers during this decade is 961·39″ (semidiameter). The mean for the period 1874–1910 is 961·18″, which agrees exactly with the value deduced by Auwers from the observations made at Greenwich during 33 years. V. NOBILE: Utilisation of spectroscopic determinations of the radial velocity in the study of the perturbed motion of stellar systems. O. CHISINI: A theorem of the existence of multiple planes (1). N. SPAMPINATO: A real algebra of four units. R. CACCIOPPOLI: A general theorem on the functions of two complex variables. O. PYLARINOS: The movement of a material point on a fixed conical surface. U. BARBIERI: Astronomical geodetic station at Monte Vesco in July 1930. S. FRANCHETTI: The phenomenon of fusion in relation to a new equation of state and to the lattice structure of solids (1). G. ZANOTELLI: The paramagnetic rotation in a variable magnetic field. The behaviour of the paramagnetic part of the Faraday effect in a variable field has been studied by the method of Beams and Allison (1927). G. R. LEVI and M. TABET: Fibrous structure in ionic lattices (2). The temperature conditions in which AgCl and AgBr give fibrous structures orientated according to (100) and (111) respectively are established, and an explanation is suggested for the variation of behaviour with the temperature. The breaking stress for the (111) orientation is much greater than that for the (100) orientation. V. PUNTONI and N. FAVIA: Loss of virulence of the tubercle bacillus resulting from association with *Bacillus tubercolophilus*. Virulent tubercular strains lose their pathogenic activity when kept in contact with *B. tubercolophilus* on a glycerine-potato medium for 1–2 years. This loss is stable and permanent, as it persists after repeated passages of the organism through sensitive animals. V. CARMINATI: Cariometric determinations on the liver of a tumour-bearing rat on a thymus diet (3). O. VERONA: Spontaneous cultures of the cellulositic aerobe, *Cytophaga Winogradskii*, n. sp. This organism appeared on unsterilised filter-paper cultures. N. SOSTER: Presence of a body of oleaginous appearance in the epidermal cells of the leaves of *Haworthia cymbiformis*. This substance, observed earlier by Guillermond in leaves of *Iris germanica*, seems to contain a phenolic derivative, and possibly flavone compounds. D. MENARINI: Differentiation of the woody elements in leguminous plants. G. AMANTEA and V. FAMIANI: Further observations on persistent beri-beri phenomena due to deprivation of the antineuritic B_1 factor.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, October 20

BRITISH PSYCHOLOGICAL SOCIETY, at 3—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1). Symposium on: "Speech Training".

Sunday, October 21

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Capt. Guy Dolman: "Lemurs, Monkeys, and Apes".*

Tuesday, October 23

UNIVERSITY OF LEEDS, at 5.15.—Lord Rutherford: "The Synthesis of Elements".*

Thursday, October 25

CHADWICK PUBLIC LECTURE, at 5.30—(at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, W.1). Prof. D. B. Blacklock: "Sanitation in Rural Areas in the Tropics and Sub-Tropics, with special reference to Housing".*

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. W. M. Thornton: Inaugural Address.

UNIVERSITY COLLEGE, LONDON, at 6.—Dr. Pryns Hopkins: "Current Events regarded Psychologically" (succeeding lecture on November 1).*

Friday, October 26

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical discussion on "Planetary Atmospheres" to be opened by the Rev. T. E. R. Phillips, and continued by Sir Gilbert Walker, B. M. Peek, Dr. Harold Jeffreys and Mr. F. J. Hargreaves.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Frederick Keeble: "The Green Plant as Agricultural Engineer" (Thomas Hawksley Lecture).

INSTITUTION OF CHEMICAL ENGINEERS, at 6.30—(at the Institution of Civil Engineers).—Prof. C. H. Desch: "The Influence of Texture on the Chemical Resistance of Materials".*

SOCIETY OF CHEMICAL INDUSTRY (NEWCASTLE SECTION), at 6.30—(at Armstrong College, Newcastle-upon-Tyne). Prof. A. J. Allmand: "Some Aspects of Photochemical Change".

Official Publications Received

GREAT BRITAIN AND IRELAND

Economic Advisory Council: Committee on Locust Control. Sixth Report: Review of the present Locust Outbreak in Africa and Western Asia and of the Investigations carried out since 1929, and a Note on the General Programme of Further Investigations. (Cmd. 4692.) Pp. 55. (London: H.M. Stationery Office.) 1*s.* net.

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research for the Year 1933. Pp. x+139+11 plates. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

The National Advisory Councils for Juvenile Employment (England and Wales, and Scotland). Joint Report on the Organisation and Development of the Vocational Guidance Service in Great Britain. Pp. 34. (London: H.M. Stationery Office.) 6*d.* net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1585 (T. 3447): Fluid Flow in Rough Pipes. By A. Fage. Pp. 11+10 plates. 1*s.* net. No. 1588 (T. 3483): An Experimental Study of the Stalling of Wings, Aeronautics Laboratory, Cambridge. Pp. 21+12 plates. 1*s.* 3*d.* net. No. 1593 (S. 180): Effect of Wind on the Take-off of Seaplanes. By E. T. Jones. Pp. 14+9 plates. 1*s.* net. (London: H.M. Stationery Office.)

Annals of the Cape Observatory. Vol. 13, Part 4: Observations of Major Planets made with the Heliometer at the Royal Observatory, Cape of Good Hope, during the Years 1922 to 1931 under the direction of Dr. H. Spencer Jones. Pp. iv+115. (London: H.M. Stationery Office.) 8*s.* net.

British Museum and British Museum (Natural History). Annual Report of the General Progress of the Museums for the Year 1933: with a Return of the number of Persons admitted to the Museums, and a Statement of the Principal Objects added to the Collection. Pp. 20. (London: H.M. Stationery Office.) 4*d.* net.

OTHER COUNTRIES

Bulletin of the American Museum of Natural History. Vol. 66, Art. 4: The American Museum Congo Expedition Manatee and other Recent Manatees. By Robert T. Hatt. Pp. 533–566+plate 27. Vol. 66, Art. 5: New and Rare Cuban and Haitian Terrestrial Isopoda. By Lee Boone. Pp. 567–598. Vol. 66, Art. 6: Studies on the Organs of Reproduction in the Nudibranchiate Mollusks. By Leslie A. Chambers. Pp. 599–641+plates 28–31. Vol. 66, Art. 7: The Pangolins and Aard-Varks collected by the American Museum Congo Expedition. By Robert T. Hatt. Pp. 643–672+plates 32–39. (New York City.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 12, No. 10: Clearing and Dyeing Fish for Bone Study. By Gloria Hollister. Pp. 89–101. (New York City.)

Technical Books of 1933: a Selection. Compiled by Donald Hendry. Twenty-sixth Issue. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Chinese Materia Medica. By Bernard E. Read. 7: Dragon and Snake Drugs. (Published by the Peking Natural History Bulletin.) Pp. 66+6 plates. (Peiping: The French Bookstore.) 1.50 dollars.

Proceedings of the American Academy of Arts and Sciences. Vol. 69, No. 7: The Volumes of Unit Mass of Liquid Water and their Correlation as a Function of Pressure and Temperature. Part 3: Steam Research Program. By Leighton B. Smith and Frederick G. Keyes. Pp. 285–314. Vol. 69, No. 8: Contribution from the Department of Biology and Public Health, Massachusetts Institute of Technology, No. 29: The Microbiology of the Upper Air, I. By Bernard E. Proctor. Pp. 315–340. (Boston, Mass.)

Publications of the Observatory of the University of Michigan. Vol. 6, No. 4: A Short-Lived Solar Disturbance. By R. M. Petrie and Robert R. McMath. Pp. 43–44+1 plate. Vol. 6, No. 5: The Variable Radial Velocity of the Star, B.D.+56° 2617 (A). By W. Carl Rufus. Pp. 45–57. (Ann Arbor, Mich.)

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 10, No. 4: Beiträge zur Geometrie der Kreise und Kugeln, 9: Einige Anwendungen der Kreis- und Kugelgeometrie. Von Sôji Matsumura. Pp. 81–174. (Tôkyô: Maruzen Co., Ltd.)

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 1: List of Publications on Indian Entomology, 1930. Compiled by the Imperial Entomologist, Pusa. Pp. ii+45. (Delhi: Manager of Publications.) 14 annas; 1*s.* 6*d.*

Field Museum of Natural History: Department of Botany. North American Trees: Guide to Charles F. Millspaugh Hall. By Prof. Samuel J. Record. Pp. 119. (Chicago.) 50 cents.

U.S. Department of Agriculture. Farmers' Bulletin No. 1729: Machinery for Dusting Cotton. By R. C. Gaines and D. A. Isler. Pp. ii+14. 5 cents. Circular No. 326: Protecting Plants in the Home Yard from Injury by the Japanese Beetle. By W. E. Fleming, F. W. Metzger and M. R. Osburn. Pp. 14. 5 cents. (Washington, D.C.: Government Printing Office.)

Carnegie Institution of Washington. Catalogue of Publications. Pp. xliv+131. (Washington, D.C.: Carnegie Institution.)

Rubber Research Institute of Malaya. Bulletin No. 5: Variations in the Composition of Latex from Clone and Seedling Rubber. By Dr. J. L. Wiltshire. Pp. v+61. 1 dollar. Planting Manual No. 6: The Uses and Control of Natural Undergrowth on Rubber Estates. By W. B. Haines. Pp. iii+23+20 plates. (Kuala Lumpur.) 1 dollar.

Federated Malay States. Report on Forest Administration for the Year 1933. Pp. 89. (Kuala Lumpur: Director of Forestry.)

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1932, under the direction of Dr. S. K. Banerji and Dr. B. N. Banerji. Pp. xiv+135+5 plates. (Delhi: Manager of Publications.) 13.14 rupees; 22*s.* 6*d.*

The Carlsberg Foundation's Oceanographical Expedition round the World, 1928–30, and previous *Dana*-Expeditions under the Leadership of the late Prof. Johannes Schmidt. *Dana*-Report No. 1: Introduction to the Reports from the Carlsberg Foundation's Oceanographical Expedition round the World, 1928–30. Pp. 130+8 plates. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press.) 16*s.*

Egyptian Government: Ministry of Public Works. Annual Report for 1924–1925. Part 1. Pp. xi+153. 20 P.T. Part 2. Pp. xi+236. 20 P.T. Annual Report for the Year 1925–1926. Part 1. Pp. xiii+178. 20 P.T. Part 2. Pp. xi+230. 20 P.T. (Cairo: Government Press.)

Union of South Africa: Department of Commerce and Industries: Fisheries and Marine Biological Survey Division. Investigational Report No. 3: Occurrence of Sulphides in certain Areas of the Sea Bottom on the South African Coast. By W. J. Copenhagen. Pp. 18+2 plates. (Pretoria: Government Printer.)

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31st, 1933. (No. 59.) Pp. 90+3 plates. (Adelaide: Government Printer.)

Norges Svalbard- og Ishavs-undersøkelser. Meddelelse Nr. 25: Norges Svalbard- og Ishavs-undersøkelsers Ekspedisjoner til Nordøst-Grønland i årene 1931–1933—Isfjord fyr og radiostasjan, Svalbard. Av Anders K. Orvin. Pp. 31. Skrifter om Svalbard og Ishavet. No. 14: Tidal Observations in the Arctic. By Rolf Kjær and J. E. Fjeldstad. Pp. 29. 6.00 kr. Nr. 62: Vascular Plants from Northern Svalbard, with Remarks on the Vegetation in North-East Land. By P. F. Scholander. Pp. 155. 15.00 kr. Nr. 63: A Contribution to the Archæology of North-East Greenland. By Søren Richter. Pp. 149. 25.00 kr. (Oslo.)

Cattle in the Tropics. By Prof. R. Cecil Wood. Pp. iv+42+4 plates. (Trinidad: Government Printing Office.) 2*s.*

CATALOGUES

The Goliath Tube. Pp. 8. (London: Cuthbert Andrews.)

Collecting Apparatus for Botany, Entomology, Pond Life, Geology, etc. (Catalogue C, eighth edition.) Pp. 48. (Manchester: Flatters and Garnett, Ltd.)

Research Chemicals Price List. Pp. 4. (London: L. Light and Co.)

NATURE

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CONTENTS

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Inland Water Survey

ELSEWHERE in the present issue of NATURE Prof. W. S. Boulton gives an account of the discussion at the recent British Association meeting at Aberdeen on the subject of underground water supply. The investigation of underground water resources is intimately connected with, and indeed, as Prof. Boulton specifically points out, forms an essential part of, a complete inland water survey, which was the subject of a second report presented at the same meeting by a Research Committee of the Association appointed two years ago to consider the matter. It is, we think, opportune to make some observations on the present position of a movement which has been growing in importance and intensity for a number of years past, and on which we have commented from time to time.

Fully three months have elapsed since on July 17, the Minister of Health, on behalf of the Prime Minister, then absent abroad, received a deputation from the British Association and the Institution of Civil Engineers, which laid before him the considered recommendation of both bodies that an inland water survey, conducted on unbiased lines and in a thoroughly scientific manner, was urgently necessary in the national interest, as a means of ascertaining definitely and unmistakably the actual water resources available, and further, as an essential preliminary to any consideration of the allocation of supplies throughout the country on a sound and judicious basis. Sir Hilton Young listened to the deputation and promised that their representations should receive the most careful consideration of the Government.

While admitting that due consideration involves time and that the holiday season has intervened, yet it is with a sense of disappointment that we have to add that so far no action has been taken. The prolonged delay is the more remarkable in view of the fact that there have been several opportunities of making some appropriate public allusion to the subject and these opportunities seem to have been studiously ignored. On October 9 Sir Hilton Young addressed a conference of water authorities at the Council House, Birmingham, summoned to consider the formation of a Regional Advisory Water Committee for the counties of Staffordshire, Warwickshire and Worcestershire. While he expatiated on the lessons of the drought and said that "it was of the highest importance that all authorities should survey the position in

the light of their new experience and prepare to meet needs over a long period of years", he added nothing about the preliminary and more pressing duty of inaugurating a technical survey to determine in an accurate and reliable way the resources which water supply authorities would have at their disposal. To be fair, we must admit that he did say that "the line of advance was to improve control of supplies by improving knowledge of them", but without any explanation or enlargement, this expression remains cryptic and indefinite. Sir Hilton had a further opportunity of making a clear pronouncement on the subject on October 18, when he addressed at Manchester a conference of about a hundred and fifty representatives of water authorities in Cheshire, Lancashire and Derbyshire, but again no indication was given of the Government's intentions.

There is reason to fear, as pointed out in a leading article in NATURE of August 4, that the question is being complicated by interdepartmental jealousies. The Government, in the face of the strong and cogent reasons advanced by the British Association and the Institution of Civil Engineers, is apparently prepared to concede the necessity for a survey and to consider the best means of carrying it into effect, but, on the other hand, there are indications that difficulty is being found in deciding which of two important departments should be entrusted with charge of the work. The Ministry of Health, for reasons which, if correctly conjectured, do not carry great weight or redound very much to the credit of the civil service, would appear to be reluctant to admit priority for the claims of the Department of Scientific and Industrial Research, which, in the view of all who are acquainted with the technicalities of a survey, is the most appropriate and indeed the only competent official body at present in existence to supervise operations of this kind. It would serve to relieve the situation in some degree if the Ministry of Health could be brought to realise that the kind of survey contemplated by the British Association and the Institution of Civil Engineers is strictly a technical procedure which need, and in fact would, in no way encroach on the province of the Ministry in regard to matters affecting the supervision of public water undertakings.

Other matters, unfortunately, have arisen to cause cross-currents of thought and differences of opinion. The allocation and method of distribution of water supplies to the best advantage of the public have lately been the subject of much controversy and argument. Mr. Alan Chorlton, in a recent presidential address to the Institution of Mechanical Engineers, has put forward a suggestion for the creation of a water 'grid', on the lines of the electricity grid which has been adopted in dealing with communal supplies of electricity. Mr. Thos. Levy, the vice-chairman of the House of Commons Committee on Water Supply, has communicated to the Press his proposal for the establishment of a Statutory Central Water Authority, "charged with the responsibility of providing a supply of pure water wherever needed". Mr. Clemesha Smith, water engineer of Wakefield, has advocated the formation of a body of water commissioners, acting in conjunction with a series of regional committees, exercising administrative jurisdiction over the whole country and empowered to raise funds and to deal with all questions of water supply. These and a number of other schemes, however laudable and attractive in many of their aspects, are, we urge, not ripe for consideration at the present juncture. They only serve to confuse the issue and to cause delay. The primary essential is a survey. The cookery book direction about the preparation of jugged hare is apt and to the point: "First catch your hare!" Until a survey has been instituted and in a large measure completed, it cannot be known with any degree of certainty and reliability to what extent supplies are actually available for distribution.

The public is, in fact, inclined to have rather hazy ideas about the availability of water supplies, and the recent restrictions of consumption imposed in consequence of the drought have occasioned some unpleasant surprise and even perplexity. Prof. Boulton, in his article in this number, remarks that during recent months, "letters and special articles have appeared in the public Press, which have given the impression that we have underground in Great Britain an inexhaustible supply of potable water, and that it is only necessary to bore down to a sufficient depth almost anywhere to get all the supplies we need", and he deplores, in connexion with the obscure and debatable practice of water divining, "the great waste of private and public money" to which it has given rise and which still continues. This haziness of perception is, in fact, characteristic of the attitude of the public towards water supply sources as a whole, about which they never trouble to inquire, so long as there is sufficient to meet their demands, some of which, it cannot but be felt, border on wastefulness. It is only

when restrictions come into force and when supplies fail altogether, as they have done recently in various parts of the country, that a correct appreciation of the position is brought home to the national consciousness.

At present, under the system of water appropriation which prevails, the country is very much in the position of a tradesman who is completely ignorant of his balance at the bank and who, when in need of cash for any purpose, dips his hand into the nearest till in his establishment and is content if he finds therein sufficient to meet his immediate requirements. Such a state of affairs is incompatible with a sound business policy. It is essential that the nation should possess an exact inventory of its water, as of its other resources, and that it should realise how far these can be made to cover all present and future demands for supplies, whether for domestic, industrial or other purposes. So far back as 1921, a Board of Trade Committee heard evidence which proved "*beyond all doubt* [the italics are ours] the urgent necessity in the national interest of some control of all water, both underground and surface". Before control can be exercised, it is essential that definite knowledge should be obtained of the resources to be controlled. Hence the primary and fundamental necessity for a complete technical survey. This is so obvious that an apology is almost necessary for reiterating it.

Indeed, we should hesitate to labour the subject as we have done, were we not acutely aware of the difficulties which arise from public misconception on one hand and of official inertia on the other. To some extent the public has come to realise in the course of recent experiences that water, while constituting one of the most important requisites of life, is not to be had merely for the asking. It is not available in unlimited quantity, and supplies may be unduly depleted and even exhausted, if not efficiently conserved and administered. Official prejudice and reluctance to accept external advice, however competent, is a more difficult matter to deal with. Thirteen years have been allowed to pass since the publication of the urgent recommendation of the Board of Trade Committee which we have quoted above. The additional emphasis supplied by the finding of the British Association Committee, with the whole-hearted concurrence of the Institution of Civil Engineers, has been laid before the Government, as also it has received in the early part of the year the Report of the Committee on Scottish Health Services, which affirms, with equal conviction, "that a technical survey of the water resources and supplies of Scotland should be undertaken *at once*" (again the italics are ours). Still there is no indication of an official decision, let alone of the inauguration of effective measures for its realisation. In contrast to the vigorous activity and enterprise which characterise the present age, Government departments continue to move

> "With the slow motion of a summer's cloud"[1].

Unfortunately, as experience proves only too surely, such dilatoriness in national affairs is attended by the risk of unpleasant consequences, and we again consider it our duty to urge the necessity for prompt action and, equally emphatically, action on the right lines. We respectfully commend to the notice of the Government the general feeling of expectancy in scientific and engineering circles which finds expression in the following resolution passed jointly by four sections (Mathematical and Physical Sciences, Geography, Engineering and Geology) at the Aberdeen meeting and referred by the General Committee to the Council: "that the British Association await with great interest the result of the careful consideration which the Government promised to give the matter, and trust that it will be favourable to the establishment of an organised survey of the water resources of the country on a scientific basis".

[1] Wordsworth: "Hart-leap Well".

Sexual Physiology as Applied to Practice

(1) *Recent Advances in Sex and Reproductive Physiology*. By Dr. J. M. Robson. (Recent Advances Series.) Pp. x+249. (London: J. and A. Churchill, 1934.) 12*s*. 6*d*.

(2) *Clinical Contraception*. By Gladys M. Cox. Pp. ix+173+5 plates. (London: William Heinemann (Medical Books), Ltd., 1933.) 7*s*. 6*d*. net.

(1) DR. ROBSON'S book is designed chiefly to meet the needs of those clinicians who seek to obtain such knowledge of recent researches in sexual physiology as will help them in their practice. The author states in the preface that the "volume deals essentially with the sexual and reproductive phenomena in the female in relation to the activity of the sex hormones". It will be seen therefore that the title is misleading; a more appropriate one would have been "Recent Advances in the Endocrinology of the Female Sexual Organs", but even within the scope of the subject as thus limited, it is not always easy to

see by what principle the author has been guided in deciding what to include and what to omit.

Prof. Crew contributes a preface, and one would have expected to find in the book some account of the work on sex change by the Edinburgh group and some mention of the researches of Lipschütz, Pézard, Domm, Zawadowsky and others. In view of the statement quoted above, it was to be anticipated that the physiology of the testis and other male organs would find no place, and this branch of sexual study is almost completely omitted; but, on the other hand, there is some account of the viability of the spermatozoa in the female generative tract. Again, there is no mention of Bissonette's remarkable discovery as to the effects of luminous radiations in inducing œstrus in the ferret though this has an obvious possible practical bearing, but Evans's work on vitamin E as a factor in placental development and fertility is referred to. One would have liked to have found some account of the pregnancy tests other than those based on the detection of hormones in the urine, since such observations cannot fail to be of interest to clinicians besides having a bearing on the secretory activities of the essential sex glands.

Apart, however, from a curious inconsistency in the selection of the subject matter, the book possesses considerable merit. It is written clearly and concisely, and shows a critical capacity which is most marked when the author is dealing with work connected with his own studies. Moreover, he is fair in his criticisms of other investigators and states their views clearly, though he may not be in agreement with them. The final chapter entitled "Clinical Applications" should be definitely useful, and the book will be of interest to the advanced student of physiology as well as to the clinician in general practice. In the references to literature at the ends of the chapters, and again in the index, it is unfortunate that the initials of the authors should not be given, especially in cases of two authors with the same name, since these are not distinguished and the work of different investigators is thereby confused. The illustrations are well chosen, but it is regrettable that some of the photomicrographs are badly reproduced. An index to the figures would have been helpful.

(2) Dr. Cox's work on "Clinical Contraception" was written at the instigation of the National Birth Control Association. Lord Horder supplies a preface stating the purpose of the book. Like Dr. Robson's work, it is written for clinicians, and it is intended to serve "as a guide to the complete application of the principle [of contraception] in general practice".

As medical officer to one of the largest birth control clinics in England, the author has had an exceptionally wide experience in giving instruction in the practical use of contraceptive appliances, and her intimate knowledge of the respective merits of some of the better-known methods of birth control is apparent in her descriptions. But Dr. Cox includes also an account of chemical, hormonic and spermatoxic sterilisation, with which her acquaintance is necessarily mostly second-hand or derived from the literature. Many of these methods are at present of problematical value, but we think that the author has done well to include some descriptions of them since they add to the interest of the subject and point the way to future developments. Contraception by means of intra-uterine appliances is also discussed, and the limitations and dangers attached to these methods are pointed out.

There is a useful chapter at the beginning of the work on the physiology of reproduction in relation to the problem, and this treats of various matters of interest and importance which are still omitted or only imperfectly dealt with in the ordinary textbooks of physiology and gynæcology. In regard to the time of ovulation in women, the author might have quoted the exact records of Dr. W. Shaw. It is scarcely true to say that ovulation is usually temporarily suspended during lactation, since Dr. Dingwall Fordyce has shown that menstruation occurs in 40 per cent of cases during actual suckling, and as the author herself states, the resumption of ovulation after pregnancy often precedes menstruation.

The chapter on the evaluation of contraceptive methods contains some interesting statistical records obtained from 'women's welfare' centres and it is shown that the clinic results, so far from being discouraging, "are surprisingly good, where the methods proved acceptable". The last chapter is on "Contraception and the Public Health Services" and this is followed by appendixes containing lists of clinics, of contraceptives, and of manufacturers and agents. Whether it was wise to include the latter without explanatory comment is doubtful since some of the appliances or substances advertised by the firms mentioned are of very questionable value. There is as yet no perfect method of contraception, and having regard to the extent to which different individuals vary anatomically, physiologically and psychologically, even within the limits of the normal, it is possible that no one mode may ever be devised such as would be suitable for all cases. Yet the study of the subject is steadily advancing with results that cannot fail in course of time to become of great advantage to the community, and the progress that is being made is clearly set forth in Dr. Cox's book. F. H. A. MARSHALL.

The World Power Conference

Transactions of the World Power Conference, Sectional Meeting, Scandinavia, 1933. Vol. 1. Pp. 763. Vol. 2: *Electrical Energy.* Pp. 702. Vol. 3: *Gas, Solid and Liquid Fuels.* Pp. 336. Vol. 4: *Power and Heat Combinations, Steam Heat Consuming Industries.* Pp. 615. Vol. 5: *Iron and Steel Industry, Electrical Heating, Transmission and Adaptation of Motive Power for Industrial Machinery.* Pp. 692. Vol. 6: *Railways, Urban and Suburban Traffic.* Pp. 781. Vol. 7: *Marine Transport.* Pp. 294. (Stockholm: Svenska Nationalkommitten för Världkraftkonferensen, 1934.)

THE management of an international conference nowadays has become no mean task. But since "practice makes perfect", those responsible for the World Power Conference, the first of which was held in London in 1924 in connexion with the British Empire Exhibition, have built up an organisation which has become a model of its kind and affords a first-rate example of what scientific management really can achieve.

The last sectional meeting of the Conference was held in Scandinavia in 1933, and there have recently appeared the "Transactions" of the meeting in seven volumes of a high standard of quality, printed in Stockholm in three languages, of which English predominates.

It was a happy thought to preface the first of these volumes with a detailed and illustrated account of the organisation: this is of value both as a record of what exactly was done and as a source of information for those who are preparing future international meetings. No detail is left unrecorded—for example, the age of the members, the numbers announcing special interest for different sections, the distribution of the members according to language, are all used to plot graphs. It is of interest that English was the most commonly understood language of the three, English, French and German, used at the Conference.

It is no longer the practice for speakers to read their original papers; these are available in type beforehand with a summary in the other two languages, as also are the general reports, which contain an analysis of the papers presented in the section together with the remarks of the reporter and suggestions for discussion, these last being printed in all three languages. Inaudibility is no longer tolerated at conferences; at large meetings, loud speakers were installed, but at the smaller technical meetings head telephones were used in a novel apparatus involving high frequency electrodynamic radio transmission, which allowed the listener to move freely about the hall. Some of the discussions were recorded phonographically. It is evident that the new methods are going to do much for international fraternising, especially when it is possible to instal them economically at meetings lasting only a few days.

General reports were presented on eleven subjects in the three languages and these are included in the first volume. The other volumes deal each with a section of the Conference; they contain the above general reports as well as the individual communications.

Reference in detail to any of these is impossible, but a few thoughts of a general character on power may be placed on record.

The production of power is a highly competitive process technically—oil, electricity, coal, gas, each in turn is used in new machines with greater economy. There is always progress.

The engineer has still a long way to go in making anything like complete use of the energy in the fuel he uses. Locomotives use but 5 per cent of the total, marine turbines but 10 per cent, large steam turbines less than 20 per cent. Gas engines use about 25 per cent of the energy in the gas supplied, a petrol or kerosene engine uses 17–20 per cent and the Diesel engine as much as 35 per cent. The energy in water can be converted usefully to about 50 per cent into power, though as this is produced at a fixed centre, transmission losses have to be taken into account.

Each of these figures is undoubtedly still capable of improvement; for example, the economy in heat consumption in the turbo-generator has increased within twenty-five years from 3,000 calories to 2,000 calories per horse-power.

Denmark, the first host of the last Conference, is not by any means an engineering industrial country, yet it has played a leading part in two matters, the development of ferro-concrete and of the Diesel engine, both at sea and on land. The pioneer ocean-going Diesel ship was built in Copenhagen in 1912; the twin engines developed 2,000 horse-power. Twenty years later, the White Star liners, *Britannic* and *Georgic*, with Diesel engines of 20,000 horse-power, are looked on as the last word in ships. To-morrow, if not already, the Diesel engine will be invading all branches of power production including the motor-lorry.

The power requirements of the world are continually increasing, and, if anything like the same rate of progress is continued, will soon necessitate the consumption of stupendous quantities of coal and oil, which presumably will become increasingly difficult to win and more costly to produce. At the moment, the only desire in all lands is to increase the consumption of both coal and oil, either to provide employment or to realise capital

assets in the lifetime of the owner. Sometime there must come a halt to this procedure; the capital is exhaustible.

Fortunately, water-power is increasingly available and, subject only to climatic variations, is inexhaustible, so that it is probable that we shall see a change over to its more extensive use, as indeed is already happening in Canada. When this day comes, the power-using industries may also have to migrate from the coalfields to nearer the sources of water power, although it may be expected in the meantime that the efficiency of electric transmission will have been improved so that factories will not necessarily have to move up into the hills. NATURE has frequently directed attention to the development of water-power in Canada, which country is particularly favoured in this respect: if the above forecast is in any way realised, the potentialities of Canada a generation hence will be very great.

It would appear at least desirable to press forward the development of such water-power as is available in Great Britain, and in this connexion a survey of our water resources appears highly desirable.

Any mention of the World Power Conference without a reference to Mr. D. N. Dunlop, its founder and most energetic leader and supporter, is of course impossible. It is understood that next year a sectional conference on chemical engineering is to be held in London. E. F. A.

Birds of Eastern China

A Handbook of the Birds of Eastern China (Chihli, Shantung, Kiangsu, Anhwei, Kiangsi, Chekiang, Fohkien and Kwangtung Provinces). By J. D. D. LaTouche. Vol. 2, Part 3: containing *Families Falconidæ (part), Columbidæ, Pteroclidæ, Phasianidæ, Tetraonidæ, Turnicidæ and Rallidæ*. Pp. 193–288+plates 18–19. Vol. 2, Part 4: containing *Families Jacanidæ, Rostratulidæ, Gruidæ, Otididæ, Glareolidæ, Dromadidæ, Stercorariidæ, Laridæ, Sternidæ, Rhyncopidæ, Charadriidæ and Scolopacidæ (part)*. Pp. 289–400+plates 20–22. Vol. 2, Part 5: containing *Families Scolopacidæ (part), Pelecanidæ, Phalacrocoracidæ, Sulidæ, Phaethonidæ, Fregatidæ, Alcidæ, Procellariidæ, Puffinidæ, Diomedeidæ, Plataleidæ, Plegadidæ, Ciconiidæ, Ardeidæ and Anatidæ (part)*. Pp. 401–496+plates 23–24. (London: Taylor and Francis, 1932–1933.) 7*s*. 6*d*. net each.

MR. LATOUCHE is getting within sight of the end of his great work, an attempt to bring our knowledge on this subject really up to date. The general format of parts 3, 4 and 5 is, of course, in agreement with previous numbers, a noticeable feature being especially brought out in part 3 when dealing with the Accipitres, the plumage of which varies in a most extraordinary manner, both in regard to sex and to age. The author gives a general description of the plumage of the male, female and nestling, and then refers also to the plumage of individual birds which do not agree with the general description. This will undoubtedly be a great help to students of this very difficult order. We are glad to see that the author keeps the genera *Astur* and *Accipiter* separate, for though these forms may in rare instances inter-grade, it is usually very easy to distinguish between the short sturdy-legged *Astur* and the long, slight-limbed sparrow-hawk.

As regards the treatment of the other families dealt with, we have little comment to make. The classification is satisfactory and up to date, and the field notes interesting and complete; in fact, one of the most noticeable features of Mr. LaTouche's work is that, all through, the reader feels he is learning something about living birds in addition to reading descriptions of dried skins. We notice that the author still retains *Ceriornis* as a generic name for the *Pucras* pheasants, but since Stuart Baker wrote his work on the birds of India, the classification of which the author has followed, it has been shown that Linnæus's name really referred to *Meleagris satyra*, and we can therefore return to the name of *Pucrasia* for these pheasants.

The author's remarks on the old English pheasant *Phasianus colchicus* are most interesting, and much information is given on the extreme geographical variation which occurs in these birds. Especially is this the case in regard to the ringed races, where he shows the great difference in the size and completeness of the neck-ring which occurs in quite small areas. Altogether the author admits ten races of *Phasianus colchicus*, of which he gives four, *torquatus*, *karpowi*, *pallasi* and *kiangsuensis*, as occurring within the limits of eastern China.

In dealing with the little Hemipodes, the author still retains *Turnix dussumieri* as specifically distinct from the European form *Turnix sylvatica*, although it is now generally, and we consider correctly, held to be merely a race of the latter. The printing of the work is excellent and misprints or slips are but few in number, but we would direct attention to the fact that on p. 204 the Formosan green pigeon has been given the generic name of *Sphenurus* instead of *Sphenocercus*.

For Part 4, the author has had the advantage of Dr. P. Lowe's most recent works on the classification of the great families of waders and has followed him practically *in extenso*. We note, however, that he still retains Baker's two orders,

Jacanæ and Rostratulæ. This is possibly wise for, as Dr. Lowe himself says, we have still much to learn about this great division, and it may well be that eventually these two most aberrant groups will have to be given the status of orders or sub-orders rather than that of families only.

We notice that in dealing with the gulls and terns, the author retains *Thallasseus zimmermanni* as a full species, in this respect following Peter's "Birds of the World". We should ourselves have considered this bird to be merely a race of *T. bergii*. Characters differentiating *zimmermanni*, "a heavier and thicker bill", do not suffice to constitute a species unless it can be shown that the breeding habits of this and some other supposed form overlap.

The author calls the Eastern grey plover *Squatarola s. hypomelana*, Pall. 1811–27, but this name is ante-dated by *Charadrius hypomelas*, Pall. (*Reise Russ. Reich*, 3, 699 ; 1776). *Ochropus*, the scientific name of the green sandpiper, should be spelt *Ocrophus*. This spelling was repeatedly employed and cannot therefore be looked upon as a misprint or clerical error.

Among some of the most interesting of the author's remarks on various birds, we note especially those in reference to the Little Ringed Plovers and that he records having found the typical form, *Aegialitis d. dubius*, in North China, giving bill measurements to show his identification is correct. The author thinks that the Large Sand Plover, *Cirrepedesmus leschenaultii*, may possibly be found breeding "all the way up the China coast in suitable places". We confess that we should be very much surprised if the author's speculations are ever confirmed. Birds of this genus, so far as we know at present, are birds of bleak areas, breeding at great altitudes or very far north, and Mme. Koslova's record of the breeding of this species is in quite typical country, the northern Gobi Desert.

In part 5 there is but little to comment on. LaTouche still retains *Capella gallinago raddei* as a race of the fantail snipe but agrees with Stuart Baker that it is doubtfully divisible. The proper spelling of the scientific name of the Malay Bittern and its allies is *Gorsakius* (Gray, "Cat. gen. and sub-gen. Birds", p. 114, April 1855) not Gorsachius ("Bonaparte Gonsp. *Av.*", 2, 138, *after* April 1855), while *Cygnus jankowskii* of Alpheraky, 1904, is the same as *Cygnus minor* of Keyserling and Blasius ("Wirbelth. Europas", pp. 132–222, 1840) and must therefore bear the latter name.

As in the former numbers, printing errors are few and the only one we have found of any importance is on p. 300, where *Calidris* has been spelt *Calibris*. We would also record that we do not ourselves agree on the retention of the name *Gygis* (Wagler, 1832), as this is invalidated by *Gyges* of Bery de St. Vincent, 1825. We think the name employed should be *Leucanous* (Mathews, "Birds Austral.", 2, 432 ; 1912).

We congratulate the author on these three parts of "The Birds of Eastern China", in which he has fully kept up the standard of the previous numbers. We are sure that the work, unlike so many others, will interest not only the scientific bird worker, but also the field naturalist and lover of birds, and that to each one of these whose interests lie in China, the work will be absolutely indispensable.

E. C. S. B.

Short Notices

Introduction to Physiological Chemistry. By Prof. M. Bodansky. Third edition, rewritten and reset. Pp. xi+662. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1934.) 25*s*. net.

THIS is the third edition and the tenth printing of this textbook since it was first issued in 1927, so it is evident that it has found wide favour and support. The research activity in the field of biochemistry is described by the author as unprecedented, a qualification with which few will be disposed to quarrel : as a result, much new information has had to be incorporated without unduly enlarging the size of the book. Additional space has been given to such subjects as enzymes, gastric acidity, muscle metabolism, the mineral requirements in nutrition, vitamins and hormones ; the question of the composition of the blood and other body fluids has been treated in greater detail.

It is a very definite achievement to condense so much information into a book of about 600 pages, which is printed in clear type with excellent chemical formulæ and numerous references to the original literature.

It is obviously impossible either to criticise or review such a work in detail ; the examination of particular chapters serves to bring out the speed at which new discoveries are being made and the new theories made to fit into the whole. A case in point is the intermediate metabolism of the carbohydrates, which has proved to be of considerable complexity ; the formation of phosphoric esters, the chain of events pictured by Meyerhof, the new emphasis laid on glycuronic acid and the discovery of ascorbic acid have all needed interpretation. Yet, as showing how much requires to be discovered, it may be cited that we are still ignorant as to the mechanism of the conversion in the body of glucose into galactose, which is the sugar of the brain and the component of lactose synthesised in the mammary glands.

Essentials of Histology: Descriptive and Practical, for the use of Students. By Sir E. Sharpey-Schafer. Thirteenth edition, edited by Dr. H. M. Carleton. Pp. x+618. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 15*s*. net.

For a textbook to retain its youthful vivacity after fifty years' wear and tear one expects that magical forces have been at work, and one is not surprised to find that the number of this new edition is the bewitching '13'. This well-known manual of descriptive histology so well conceived by Sir Edward Sharpey-Schafer has served as the chief handbook of medical students for two generations, and there are many instances where both father and son have used it; now there is also the possibility of the grandson using it as well. This is indeed a remarkable achievement for a scientific textbook. With the co-operation of Dr. Carleton we now expect it to run into the next century.

As indicative of its rejuvenescence, we may point to the inclusion of a new section on the development of the cells of the blood. This account is in line with the findings of Miss Sabin and her co-workers. It is a subject which has assumed prominence in recent years in view of the success which has attended the treatment of pernicious anæmia with liver extract. Another section which has been remodelled to conform with the advances made in other fields is the growth and development of bone.

The substitution of photomicrographs in selected instances for line drawings has made a further appeal to the student in thus more nearly approaching to the appearance revealed by his microscope. Although he does not obtain as complete a picture as the composite line drawing of many observers yet the strain on his faith in his teachers is easier to bear. This textbook is likely to remain the favourite account of descriptive histology to medical students.

Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise. Begründet von Prof. Dr. Friedrich Dahl. Weitergeführt von Maria Dahl und Prof. Dr. Hans Bischoff. Teil 28: *Tausendfüssler oder Myriapoda.* 1: *Diplopoda.* Von Dr. Otto Schubart. Pp. vii+318. (Jena: Gustav Fischer, 1934.) 24 gold marks.

This is one of an excellent series of publications dealing with the organisms of the countries bounding the southern part of the Baltic, including Denmark, and those parts of Germany and Holland against the North Sea. This may not be a geographical region, but there are certain similarities in environments, both of land and water, so that it forms a convenient entity. Millipedes here are considered in an entirely systematic manner, and they are well treated, with tables for the identifications of family and genus, the whole accompanied by a good bibliography. Each species is given an excellent and well-illustrated systematic description, and this is followed by accounts of its biology and distribution. Clearly we have a reference book necessary to every library of zoology and one not likely to be superseded for several decades.

An Essay on Philosophical Method. By R. G. Collingwood. Pp. xii+227. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 10*s*. net.

Mr. Collingwood has produced a profound and useful monograph which raises and discusses the question of what philosophy is and what methods should be used in approaching it. Owing to the variety of systems in existence, it may seem that classification should render some service to philosophy. Yet, the theory of classification, which may be applied to exact as well as to empirical sciences, cannot be rigidly applied to philosophical concepts. The determination of a scale of forms is the first objective of the philosopher. Then he must consider the quality of his judgments and of its inference in all their aspects; only then can he hope to build up a systematic whole and pass judgment on its value. The views expressed by the author require careful consideration, as his suggestions will be found to be extremely important in a subject which appears to the layman, wrongly we believe, to be in a chronic state of chaos. T. G.

Vie et rajeunissement: une nouvelle méthode générale de traitement et mes expériences de rajeunissement de Bologne et Paris. Par Dr. Francesco Cavazzi. Pp. xii+73+17 plates. (Paris: G. Doin et Cie, 1934.) 22 francs.

This is a communication made to the Society of Medicine of Paris with discussion and author's reply. The new method of treatment is the subcutaneous injection of the serum of the efferent vein from the testicle of a young healthy animal. It is stated that the internal secretion of the testicle flows into the blood stream so soon as it is formed, and therefore the serum is more potent than an extract of testicular tissue. Remarkable rejuvenating effects are claimed. A record of cases with photographs is given, showing that the effects last for at least two or three years. It is suggested that the effects are due not to a temporary stimulation which would use up the existing available energy of the body, but to the improved nutritional state of the central nervous system, especially the spinal cord.

The Naturalist on the Prowl. By Frances Pitt. Pp. x+137+32 plates. (London: *Country Life*, Ltd., 1934.) 5*s*. net.

In easy style, Miss Pitt achieves the double purpose of presenting a series of descriptive and pictorial vignettes of animal life in the country, and of revealing how the novice may attempt to follow in her steps. Her quarry ranges from spiders' webs to bats, otters and seals, but it is mainly birds, and the account of blackcock tournaments, repeatedly observed when no female birds were present, shows that sexual selection may not enter into what appears to be an ebullition of high spirits.

Some of the photographic hints are well worth consideration by experienced workers, such as the possibility of using a hide without elaborate camouflage, and the desirability of carrying a selection of lenses of different focal lengths. Miss Pitt's photographs justify the means.

New University Buildings at Cambridge

The New University Library

THE University Library, after occupying its old site for four hundred and sixty-four years, has now removed to a new building on a new site. The difficulties, not only of storage but also of the proper handling of the books in a medieval building, have long been recognised, and records of debates in the Senate House on what ought to be, or could be, done go well back into the last century. Many suggestions for alterations and hoped for improvements were made from time to time, but all with the view of remaining on the old site. Ideas for additional stories, for covering in the old courts, for excavating cellars underground were in turn suggested and debated, but without any definite move ever coming out of it all.

Meanwhile the pressure on the Library steadily grew: a flood of books burst out after the War and the problem of how to store, handle and make accessible a collection increasing each year by as much as a third of a mile of shelving became more and more acute. All available space in the town was requisitioned and each part contained its host of 'little used' books which necessitated an outlay on a special messenger service.

In 1921 a definite move was made to tackle the situation seriously, and a syndicate was appointed to consider the needs of the Library and the best way of meeting them. The syndicate reported in due course that in its opinion the only method was to build a new library on a new site. This suggestion was adopted by the Senate, not without some opposition from those who regretted a break in the historical continuity of the old site and who perhaps dreaded the upheaval (the Library Syndicate allowed three months for the move; actually it was finished, without a hitch, in eight weeks).

The special syndicate then proceeded to consider possible sites, and chose that of the King's and Clare playing fields across the river (the Eastern Hospital during the War) as the most central and accessible of the few remaining positions that were available. The two colleges concerned showed great public spirit in meeting the wishes of the University, and eventually Sir Giles Scott was asked to prepare plans for a new library.

At that time, although the financial aspect was a matter of grave concern, the University, recognising the desperate need of the Library and its importance as the pivot on which so much of its work turned, determined to risk all and go ahead. Certain bequests and the assistance of the Rockefeller Foundation, which agreed to take into consideration the University outlay on the Library to count as part of its contribution to the Rockefeller scheme for certain scientific departments in the University, thereby greatly eased the situation. A complete building has, therefore, been opened by H.M. the King instead of, as might have been the case, only a part awaiting time and opportunity for its continuation.

Sir Giles Scott has planned a building which combines an exterior of great dignity with an interior admirably designed for its purpose. Libraries differ considerably in their policy towards their readers. All of them provide one or more reading rooms, and the Cambridge Library for the first time in its career has followed suit with a main reading room to accommodate two hundred readers, not to mention smaller rooms for special purposes and tables and seats in all the book stacks. The Library, however, has a policy, not to be found everywhere, of allowing all members of the Regent House and, under certain not very arduous regulations undergraduates as well, free access to the great majority of the shelves. This is a great privilege, since in looking for one book another may be noticed the existence of which the reader was previously unaware. In addition, most books can be borrowed and taken away home or to the laboratory.

The needs of those working in the sciences do not differ materially from those of readers in other branches of knowledge, and the same general rules are made to apply to all. It is impossible to give a full account, or even a partial one, of the scientific books in a general collection of a million and a half volumes, but mention may be made of the periodical department. Periodicals form a branch of literature much consulted by the sciences. To this department a large wing is devoted. Current numbers are to be found in pigeon holes, and the bound volumes of each series are close at hand; all 'dead' periodicals are stored elsewhere to avoid confusion but are easily obtainable. The classification is minute, and there are some eighty separate headings into which the sciences are divided.

Apart from its service to present readers, a great library has another function to perform, namely, that of conservation of literature for the reader of the future. This applies especially to those few libraries, of which Cambridge is one, which receive books under the Copyright Act, and this is perhaps the main reason why many libraries allow no book to pass out of their precincts. In Cambridge the risk of undue wear and tear on books and periodicals that are likely to be much used as laboratory tools is minimised by the use of the numerous well-equipped libraries attached to the

various departments, such as the Balfour Library of Zoology, the Philosophical Society's library and those attached to the Departments of Botany, Geology, Physiology and so on, to mention only those concerned with sciences. The colleges in their libraries are more and more taking heed to the needs of the undergraduate as well.

Science has its rarities in the book world, not equal in fame to Caxtons or folio Shakespeares, but of these the University Library has its fair share. The scientific worker is usually concerned with the more modern book and with the facility with which he can obtain it. This aim the new University Library now satisfies as never before.

C. F.-C.

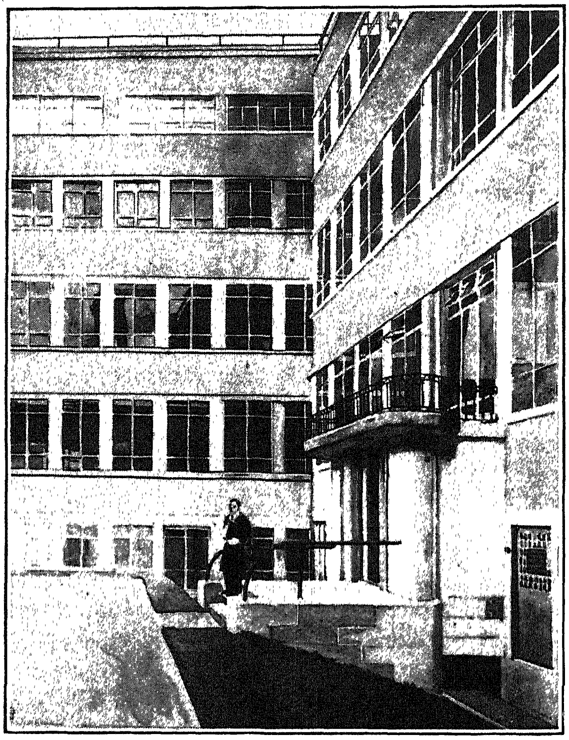

FIG. 1. Drawing of the north-east corner of the Zoology Court with the main entrance.

NEW DEPARTMENT OF ZOOLOGY

The University of Cambridge only awoke to an interest in biological science about sixty years ago. The evolution controversy between Huxley and Owen at the British Association meeting at Cambridge in 1862 started it. There were at Cambridge collections of vertebrate animals, insects and birds, and both controversialists undoubtedly urged their proper housing. In consequence Cambridge decided to build a museum, the opening of which was followed by a proposal to create a professorship. Finally, Newton was appointed professor in 1866. His department consisted of a room for himself, and here he used to meet all who cared to come, conducting informal classes. Arthur Balfour used to say that he enjoyed these, and he introduced his younger brother, Francis Maitland, who in the next ten years established embryology as a distinct division of animal science. Newton lent F. M. Balfour his private room for practical classes in 1875, and the University created a chair of animal morphology for him in May 1882, but he lost his life when climbing a spur of Mont Blanc two months later. Among his pupils in this period were Sedgwick, Garrod, Milnes Marshall, Bridge, Hickson, Lister, Weldon, Harmer, Shipley and Bateson, all men of high repute in zoological science.

The chair of animal morphology died with Balfour, but his teaching was continued by Adam Sedgwick first as lecturer and then reader at a nominal salary of £100 a year, Trinity College providing a fellowship and other emoluments. Other colleges, noticeably King's, Christ's, John's and Caius were similarly benefactors to the new Department, and so the Cambridge school of zoology grew into existence. Classes increased and biological teaching for medicine was called for, and the University raised the roofs over the Department of Mineralogy and over the Philosophical Library, providing large and most picturesque attics for practical zoology. Sedgwick succeeded Newton as professor, remaining such for two years before moving to the Imperial College of Science. I succeeded him and in my first year I had to have a research guest in my own room, which was also my office and the storeroom for the research material of Balfour and others, as indeed it remained for twenty-five years more. Classes in comparative physiology, entomology and hydrobiology were established, and it soon became apparent that they were filling long-felt wants. The University helped the subject all it could, adding rooms vacated by mathematics, botany and physiology in turn, thus providing a ramshackle and widespread laboratory, no part of which was even reasonably fireproof, or suitable for that experimentation which the modern development of zoology makes imperative. The task before the University was to provide a modern building for at least 400 students and 36 research workers, these being the laboratory attendances of 1932–33.

The Empire Marketing Board was interested in entomology and offered a conditional grant. This led to an investigation by the Rockefeller Trustees that embraced not only the biological departments of Cambridge but the University Library as well. The necessary sum to secure a Rockefeller grant was raised by private donations and by a State grant. Zoology benefited both by building costs and endowment for experimental zoology

(comparative physiology) and for entomology, and to these the University added such funds as were necessary to build an entirely new laboratory, where the Medical Schools formerly stood, only one wall of which was retained.

The Zoological Laboratory as it now exists occupies three sides of a square, the fourth or west side belonging to chemistry. The north side is the old Museum building with a vertebrate hall to the north. The director of the Museum is also reader in vertebrates and he conducts the advanced and research classes of his subdepartment in this building. The vertebrate museum includes both living and fossil forms treated together as is necessary for any study on evolutionary lines. Associated with it are eight research rooms which are a hive of mechanical and chemical industry as the fossilised vertebrates, collected by workers in various parts of the world, are developed. There are also housed here large collections of insects and other invertebrates, but the labelling and illustration necessary to successful display allow only a very few forms in each group of animals to be shown.

The other sides of the square form the new building, which is hence L-shaped, 292 feet long by 43 feet wide. It has a basement and four floors above, with the lecture room extending from the basement through the ground floor at one end. The construction is steel and concrete with narrow stanchions 13 feet apart in the walls, one row of stanchions down the centre to carry the cross girders. The whole is faced with brick. Between the steel stanchions are secondary false columns and behind these are carried the necessary services to all rooms. Except for these narrow divides, the wall is glass on each floor above the bench level. Three staircases are necessary to secure the requisite safety of the occupants, and the roof, of concrete, is flat. The upper floor is slightly recessed, this and a slight narrowing at the inner angle giving pleasing effects of light and shade. At the outer corner of the laboratories lies an old building, once used as a medical museum; it has been reconstructed and opened up, thus giving a wing, 65 feet deep, on the three lower floors.

The whole of the ground floor forms one great teaching laboratory, the service being from the wing. It has six rows of working benches, of which five are divided into student's places, each between four and five feet long, with a locker and the necessary electric lamp; about two hundred students can be accommodated. The central sixth row forms a series of demonstration benches, and these are fitted with water, direct and alternating current and compressed air, so that the demonstrators can start and carry on experiments for their individual classes. The lecture room has its projector and cinema.

The first floor carries the necessary offices and an advanced laboratory with places for thirty students, each of whom has a cupboard and shelves which extend outwards from the benches and form partial partitions. There is special provision for aquaria and for section cutting, and the laboratory has its own library. On the same floor are the Balfour and Newton Libraries, the former with about 25,000 catalogue entries; it has been developed in the last fifty years on the nucleus of F. M. Balfour's books presented to the University by his sister, Mrs. Sidgwick. The latter library is the bequest by Prof. Alfred Newton of his specialist ornithological library. There are also eight research rooms off a central corridor lit by borrowed light; these are devoted mainly to systematic and invertebrate zoology and here the collections of the Murray Expedition are at present housed. The professor of genetics is a guest in the Department on this floor, pending the provision of laboratory accommodation for this subject by the University.

FIG. 2. Northern wing of the Elementary Zoology Laboratory.

The second floor is the Subdepartment of Experimental Zoology, the teaching of which, formerly termed comparative physiology, has been a feature of Cambridge zoology for the last twenty-five years. At one end is an advanced laboratory with window benches for routine work and central benches, on which experimental problems, which

may extend over several weeks, are worked out by the students. It has its own workshop and dark rooms, students being required to set up and even to make their apparatus. Every part of this floor is equipped with direct and alternating current, gas, water and compressed air. There is an aquarium, where animals under continuous observation are kept, apart from the larger basement rooms designed for freshwater and marine aquaria. The rest of the floor is devoted to research, and there are sixteen separate rooms as well as three dark rooms, the necessary workshops and a special chemical room. A feature is the control of temperature in each room, and there are also four constant-temperature rooms in the basement, which can give a range from arctic to tropical conditions. Freshwater biology has a special centre here.

The top floor is the Subdepartment of Entomology—but subdepartments are not rigid entities, all interdigitating, their research students working where facilities can be most conveniently given. Here are a large incubator room, a freshwater aquarium, insect rearing rooms and nine research rooms. In addition, there is a field station situated near the University farm, with its laboratories and its greenhouses ranging to tropical heats in which locusts are most happy, the whole built on 2½ acres of ground, where large-scale experiments are possible.

Perhaps the most important and indeed unique feature of this new zoological laboratory is the extensive provision in all parts for keeping animals alive and under observation in conditions closely approximating to those occurring in Nature, special attention being paid to temperature and humidity in all parts. The furniture of the whole building has been especially designed and is interchangeable ; each worker has his own cupboard, bookcase and writing table. The rooms are for the most part 13 ft., 19½ ft. or 26 ft. long with two, three or four window units, and 17 ft. broad. The walls between the same are of hollow tiles, and it is a simple matter to remove or to build, according to the needs of any research. The whole, indeed, internally simulates factory construction, allowing the maximum adaptability, the planning being on the idea that all scientific buildings should be such that their use can be altered as the centres of scientific interest shift. Every floor can be gutted, leaving the strength and rigidity of the building as great as ever. A shift, however, seems unlikely just at present, for the Department is housing 57 research workers (including the staff) as well as 26 advanced and about four hundred elementary students.

J. S. G.

Underground Water Supply

ONE of the subjects discussed at the recent meeting of the British Association at Aberdeen was that of the underground water supplies of Great Britain, which occupied a morning's session of Section C (Geology). Public anxiety as to the sufficiency and proper distribution of water supplies during the recent drought was partly a reason for choosing this topic, but there are deeper and more cogent reasons which prompted the present writer to introduce it, and the interest shown by geologists and engineers who took part in the discussion was a sufficient justification for departing from the more usual type of paper and discussion in this Section. The Committee on Inland Water Survey, inaugurated at the York meeting of the British Association two years ago, submitted a report to Section G (Engineering) at the same meeting, in which reference was made to the joint deputation of the British Association and the Institution of Civil Engineers to the Government, urging the necessity of a complete and systematic survey of the water resources of the country. The very timely and forceful leading article which appeared in NATURE on August 4, dealing with the reception of this deputation, will be fresh in the minds of many. But the chief motive which weighed with the writer in opening the discussion in Section C was to rouse geologists to the urgent need of investigation of our underground water resources, not merely by accumulating, checking and co-ordinating records at present available, but also by starting new hydro-geological investigation, the results of which should be available ultimately for public use.

It is startling to find how much misconception exists when the subject of underground water is discussed by general folk. During recent months, letters and special articles have appeared in the public Press, which have given the impression that we have underground in Great Britain an inexhaustible supply of potable water, and that it is only necessary to bore down to a sufficient depth almost anywhere to get all the supplies we need. Again, water engineers, who are fully alive to the importance of some reform in conserving, developing and allocating underground supplies, think mainly in terms of the present and potential yield of existing wells and borings.

The opening up of new sources of supply usually means starting a fresh investigation, laboriously collecting new data where available, which when

they have served their immediate purpose, may lie dormant in the private possession of some individual or water authority, and in some cases are lost or forgotten.

It is true that statistics of existing water undertakings have been collected for many years past by the Ministry of Health, and used for official purposes, and the Geological Survey also collects records of wells and borings, where they are likely to help geological mapping, and, incidentally, hydrological data are also recorded. But, as the Director of the Geological Survey reminded us in the discussion, the Survey has no powers to investigate underground water. We all recognise the great value of the County Water-Supply Memoirs already published by the Survey, due largely to the enthusiastic labours of the late Mr. Whitaker, and other similar memoirs are in preparation. Yet these memoirs are necessarily a compilation of records of data and facts supplied by well borers, water undertakers and others, many of them unchecked and antiquated, and some of them supplied by incompetent persons, so that the records may be useless and even misleading.

If the Geological Survey were to undertake a systematic survey of underground water in Great Britain, it would mean the creation of a new branch, adequately financed and staffed for the purpose, as in the case of the Geological Survey of the United States.

One of the points raised in the discussion was the desirability of the compulsory registration of all well sinkings and borings for water below 100 feet in depth, as is required by the Act of 1926 for all mineral borings; and a resolution to that effect was sent to the Council of the Association from Section C. In the case of borings and sinkings for minerals, secrecy for a period of ten years may be imposed by an owner on the Government department receiving the records, but in the case of borings for water, it was generally thought that such claims for secrecy would be seldom lodged.

Attention was also directed to the very large quantities of underground water now being separately pumped by industrial undertakings, sometimes to the serious depletion of public domestic supplies. As the law governing underground water stands at present, it is possible for an individual or company to put down a deep well or boring in the immediate vicinity of an existing pumping station belonging to a statutory water undertaking, and from it pump water in such large quantity as to interfere with and perhaps seriously deplete the public supply, which may be the sole source of supply for a large community. In such a case there is no penalty or restraint imposed on the private owner, nor any compensation allowed for the statutory undertakers. Whereas the statutory undertakers have imposed upon them the obligation of fully compensating the owners of wells and borings within a radius, it may be two miles or more, if it can be shown that they have produced interference by their pumping.

Another matter referred to was that of geophysical methods of investigating underground water, and also 'water divining'. Fortunately, the latter subject was allowed to drop, otherwise there might have been much time spent—and heat generated—to little purpose. But in passing, one is tempted to refer in this connexion to the great waste of private and public money which still continues, and to a much greater extent during the past year or so.

Attention was directed, in opening the discussion, to the need of systematic study of hydrogeological conditions in natural unit areas, such as a single watershed or geological formation, or well-defined tectonic area. This would involve periodic observation of the depth and movements of the underground water-table in wells and borings, gauging of springs and streams, records of quantities and analyses of underground water pumped, pumping levels, effect on neighbouring wells, and so forth. Surface configuration, rainfall, and cultural features, as well as underground geology, would naturally come into the picture. By using the published ordnance maps, it would be possible to assemble in graphic form such a body of hydrological fact, so that ultimately one might look forward to hydrological survey maps being available for all the more important areas in the country. One of the speakers in the discussion suggested that some of these hydrological data might be inserted on the geological maps published by the Geological Survey. Many of these maps, however, are already so crowded with detail that it might be better to have a separate series of ordnance maps with hydrological data superposed and perhaps the geology in outline.

There was general agreement that such investigations are urgently needed, and that the work should be undertaken if possible in the near future. Competent individuals or groups, with the necessary acquaintance with the local geology, could doubtless do something in furtherance of this investigation, but it was felt that some national organisation is required, if such a general survey is to be undertaken for the whole country.

Thus we are faced with the same problem which the British Association Committee on Inland Water Survey is attempting to solve. Indeed, investigation on underground water, as implied by its inclusion in the terms of reference of the Committee, is intimately connected with river gauging and surface supplies in general.

No one who has been following the trend of thought among water engineers and all those interested in our water resources during the past year, can fail to be impressed by the almost unanimous desire for some Government action which will respond in a practical way to the repeated demands for an organised survey of our water resources. Increasing quantities of water, for an ever-increasing variety of purposes, are required, and the first necessity is to know where and in what quantities they are available, both above and below ground. As already indicated, this information cannot be obtained merely by collecting such data as are at present known, and of the kind which the Ministry of Health has been collecting, and which is compiled in the Water Supply Memoirs of the Geological Survey. But this is not to minimise in the least the importance of the systematic collection and collation of existing data, which are of primary value, and must be continued and extended.

An increasing body of opinion is demanding that there should be some central Government authority exclusively concerned with our water supplies. Further, when we realise the diversity of surface configuration, geology and hydrological conditions, as well as population and industry, in the various regions of the country, it becomes evident that the conservation and allocation of supplies should be dealt with in the first instance by local or regional bodies with statutory powers, but subordinate to the central authority.

In planning any such national scheme it is important, in the writer's opinion, to provide so that scientific investigation of overground and underground resources is kept separate from the purely administrative branch, which would be concerned with the allocation, distribution and conservation of water. The continuous and systematic gauging of rivers and springs, and the varied problems involved in underground hydrology, should be pursued independently of the immediate use of the water for any single interest or authority or combination of such, in much the same way that the national survey of our rocks and minerals by the Geological Survey is run independently of any one industry or profession, but is meant to serve any or all national interests.

It is for this main reason that the writer would prefer that the more purely scientific part of hydrological investigation which is now under consideration should be brought under the control of the Department of Scientific and Industrial Research, or a special branch of that Department. This need not mean that there should be any sort of barrier between the Department of Scientific and Industrial Research and the central or the regional water authorities here envisaged. On the contrary, there should be the closest collaboration between the investigation side (which would be continuously adding to our knowledge of the amount and location of available resources) and the more practical engineering and industrial side.

In any such comprehensive and national scheme, there might still be room for valuable work carried on by competent and enthusiastic geologists and others, whether amateur or professional. Short of a whole-time staff of Government experts, capable of conducting a systematic survey for the whole country, which may be impossible under present conditions, it would be possible for the Department of Scientific and Industrial Research to assist by money grants this work, and provide for its publication in such form as to be readily available for public use. W. S. BOULTON.

News and Views

Intellectual Freedom

GENERAL THE RIGHT HON. JAN CHRISTIAAN SMUTS was installed on October 17 as Rector of the University of St. Andrews after the honorary degree of doctor of laws had been conferred on him by Mr. Stanley Baldwin, Chancellor of the University. In the presence of a distinguished audience including Sir James Barrie, a former Rector, whose address twelve years ago on "Courage" is still vividly remembered, General Smuts addressed his constituents. He delivered a characteristic speech on "The Future of Liberty", and the students of the scarlet gown gave him an enthusiastic welcome and a most attentive hearing. South Africa and Scotland are linked together by many ties including the love of liberty—"We decline to submerge the individual in the State or in the group, and we base our organisation of the State and society on individual freedom and the free initiative of the citizen". Surveying the condition of the world as it passed through and emerged from the War years, General Smuts admitted that "mankind stands perplexed and baffled before the new situation and the new problems". But in spite of all grounds for anxiety, General Smuts finds none for real pessimism—having passed through rough passages, having sampled the world and human nature at many points, he remains at heart an optimist.

IN a striking tribute to science, General Smuts claimed that it would provide a solution of many of the difficulties of the age. "Science has perhaps made more fundamental progress in the last thirty years than in the preceding two thousand. In particular, as is to-day commonly recognised, the problem of food shortage, of starvation and famines, the most

dreadful spectres of all history, is at last yielding to science, and the most fruitful cause of war in the past is thus being eliminated. Instead we are now oppressed with the novel problems of plenty, the solution of which will in due course mean not only the passing of war, but of grinding poverty and slavish toil for the masses of mankind. In these and other ways the scientific results of the last twenty years will come in the future vastly to overshadow in importance the losses and dislocations of the Great War which still bulk so large in our view." General Smuts believes that scientific invention will make war more and more impossible. There is a more serious problem even than the risk of war, and that is the maintenance of liberty. It is the decay of principles that must be feared, and the disappearance of intellectual freedom. Every sincere thinker and every scientific investigator must welcome the challenge of this rectorial address. We must seek, with John Milton, to preserve "the high hopes and aims, the diligent alacrity of our extended thoughts and reasonings in the pursuance of truth and freedom".

Memorial to Carl Daniel Ekman

An interesting ceremony was performed on behalf of the Swedish Cellulose Association by Consul T. Lundgren on October 19, when he unveiled a memorial to Carl Daniel Ekman, the inventor of the sulphite wood-pulp process, at Northfleet Cemetery. In the addresses by Baron Palmstierna and others at the dinner afterwards given by the Swedish Chamber of Commerce in London and the Society of Swedish Engineers in Great Britain, great emphasis was laid on the strengthening of Anglo-Swedish relations by mutual exchange of experience in science and technology. Sweden owes much to the many English pioneers who settled in Gothenburg during the last century and organised railways, exploited iron ore deposits and developed industrial life generally in the west of Sweden, but the debt has, however, been amply repaid by the work in England of many Swedes. The current issue of the Yearbook of the Society of Swedish Engineers deals with the work of some of these, such as Alfred Nobel, John Ericsson (1803–89) the inventor of the marine propeller and the first steam fire-engine, Nordenfelt (1843–1920) the gun and submarine designer, Sandberg (1832–1913) of steel-rail fame, and Ekman (1847–1904).

In 1870, attempts were being made to improve Mey's steam-cooking process for the conversion of wood into pulp for the manufacture of paper by adding soda to the liquor, but even then the product was not entirely satisfactory; it was not until 1872 that Ekman at Bergvik found that a solution containing sulphurous acid and magnesite was the key to the problem. He thus laid the foundation of the sulphite process, the present world-production of which (6,130,000 tons a year) exceeds that of the sulphate or mechanical process in quantity as well as in value; further, the consequent cheapening of paper has brought the pleasures of reading into many homes. In 1883, Ekman became manager of a mill at Northfleet, Kent, and it was in his well-equipped laboratories there that much of his work on digesters and beaters and on the utilisation of the waste liquors was carried out. Ekman was the traditional type of inventor, and economics had no place in his enthusiasm for his technical work. As a result he died a poor man, and since the subscriptions to his memorial fund were devoted to the Ekman family and to the founding of scholarships, his grave became neglected. The memorial at Northfleet Cemetery is a result of the attention directed to this fact by Mr. J. Strachan, of the present Northfleet Mills.

England–Australia Air Race

Mr. C. W. A. Scott and Mr. T. Campbell Black arrived at Melbourne at 5.35 a.m. (G.M.T.), on Tuesday, October 23, thus winning the England–Australia air race. The flyers left Mildenhall, England, at 6.35 a.m. on Saturday, October 20, thus completing the journey, a distance of 11,300 miles, in 2 days 23 hours. The aeroplane was a new D.H. Comet, constructed at the de Havilland works specially for the race. It was a low-wing monoplane with two unsupercharged Gipsy Six engines (230 horse-power). Mr. C. W. A. Scott has already several notable flights to his credit. In 1931, he flew from England to Australia in 9 days 4 hours 11 minutes, in 1932 he did the same journey in 8 days 20 hours 44 minutes, and in 1931 he flew from Australia to England in 10 days 23 hours. Mr. Campbell Black set up a new world Puss-Moth record in 1931 by covering 1,600 miles in a single day. The second arrivals at Melbourne were Mr. Parmentier and Mr. Moll, flying a Dutch K.L.M. (Douglas) air liner carrying three passengers, who reached Melbourne at 12.54 a.m. (G.M.T.) on October 23, thus having completed the flight in just over three days. The flights are noteworthy achievements, for which tribute is due to the pilots for their skill and endurance, and not less to the designers and makers of the engines.

Memorial to Capt. Cook

On October 15, during the Victorian centenary celebrations at Melbourne, the cottage from Great Ayton, North Riding of Yorkshire, associated with Capt. Cook, which was purchased by Mr. W. R. Grimwade, taken to Australia and re-erected in Fitzroy Gardens, was formally handed over to the care of the Melbourne City Council. On the same day, at Great Ayton, Mrs. R. Linton, wife of the Agent-General for Victoria, unveiled a memorial which has been erected on the site once occupied by the cottage. The memorial consists of an obelisk of granite blocks brought from Cape Everard near Point Hicks, Australia, and is a facsimile of the obelisk at that spot, which states that Cook "First sighted Australia near this point which he named 'Point Hicks' after Lieutenant Zackary Hicks who first saw the land, April 19th (Ship's Log date), April 20th (Calendar date) 1770". In reply to a vote of thanks to Mrs. Linton and himself, the Hon. Richard Linton said: "We stand to-day beside a granite monument. It is a piece broken off from that

continent whose discovery by Cook began the process of events that gave Britain one of the most faithful and loving of her daughters. It has been sent you in exchange. We have taken from you the home in which Cook's father and mother lived, which this day is being opened in Melbourne in one of the loveliest of our gardens. Beautiful English trees overhang it, green English lawns surround it, and glowing flowers form its setting." In the course of his speech Mr. Linton said: "Such men as James Cook are beacons. In our schools it should be our care that men like this should be held up to our children to follow, quite as much as those great warriors whose ultimate building lay through destruction rather than in construction."

The Linnean Society of London

The annual dinner of the Linnean Society of London was held at the Hotel Washington on October 18. The president, Dr. W. T. Calman, was in the chair, and the official guests were Sir Richard and Lady Gregory, and Dr. G. F. Herbert Smith. Following the dinner, a reception was held by the president and Mrs. Calman in the rooms of the Society at Burlington House. Dr. J. F. G. Wheeler, director of the Bermuda Marine Biological Station, gave a lecture, illustrated with coloured lantern slides, on the natural history of Bermuda. A number of zoological and botanical exhibits were shown in the library, including a series of manuscripts and printed documents, from the Society's archives, relating to the younger Linnæus, and to his visit to England in 1781–82. The Botanical Department of the British Museum (Natural History) had on view a large series of coloured drawings of fungi of the genus *Russula*, and a selection of dried plants from British Columbia. Miss F. L. Stephens exhibited cultures and microscopical preparations of two species of the fungal genus *Neurospora* showing varying degrees of the 'sub-sexual' difference known as heterothallism. A selection of coloured fruits and seeds exhibited by the Royal Botanical Gardens, Kew, attracted much attention. Prof. G. D. Hale-Carpenter showed a series of butterflies with marks on, and mutilations of, the wings caused by the attacks of birds. Capt. J. G. Dollman exhibited a series of skins of certain antelopes showing the uniformity of pattern in the fœtal and young animals, with diversity in the adults. Mr. J. Omer-Cooper had on view a living specimen of the crustacean *Apus*, hatched from mud taken from a pond in the New Forest. This crustacean had not been found in England for about half a century.

Rainfall Records and Drought Periodicity

Mr. W. R. Baldwin-Wiseman, lecturer in hydraulics in the University of Western Australia, writing in reference to our leading article of August 4 on the "Government and Inland Water Survey", emphasises the need for an organised hydrographic service, and instances the Hydrographic Survey of the Po as one of the most efficient services in the world. From analyses of many lengthy records of rainfall in his possession, he contends that there is little justification in many cases, and no justification in some, for the assumption that any 35-year-mean approximates fairly closely to the true mean, or that a 20 per cent deficiency adequately represents the average annual deficiency of the three driest years in a lengthy rainfall record. Consequently, water works planned on these assumptions may make a too generous allocation of compensation water, while making inadequate provision for a storage sufficient to tide over the contingencies arising from a prolonged, or frequently recurrent, drought. He goes on to point out that Dr. E. Huntington has demonstrated the existence of a climatic pulse of about 640 years, which is probably a multiple of the sunspot period of 11·2 years ($57 \times 11{\cdot}2 = 638{\cdot}4$); if A.D. 1372, the year of maximum sunspot activity in the Chinese record, which has now been unofficially maintained for nearly a thousand years, be taken as a nodal point in this pulse, previous points will have occurred about 543 B.C., A.D. 95, and A.D. 734—all four points being in periods of notorious aridity. If the sequence is maintained, the next occurrence may be expected about A.D. 2010, with a prevalence of drought conditions, either prolonged or frequently recurrent, towards the close of the present century.

The North-East Coast Institution

At the annual general meeting of the North-East Coast Institution of Engineers and Shipbuilders held at Newcastle-upon-Tyne on October 19, the report for 1933–34 was submitted, and Mr. J. T. Batey delivered his presidential address. In spite of the severe depression in the shipbuilding industries, the membership of the Institution has been well maintained, several valuable papers have been read and attendance at meetings during the past year was the highest recorded. Among other matters referred to were the grant of armorial bearings, the Sir Charles Parsons Memorial and the opening on July 20, 1933, of the Municipal Museum of Science and Industry, the formation of which the Institution did much to promote. The honorary curator of the Museum is Capt. E. W. Swan, a member of the Institution. A part of Mr. Batey's address was devoted to the problem of using technical progress. Technical progress, he said, is like a fine machine; it has to be properly used or it may be dangerous. Mechanical science has outstripped progress in the science of living, and it is evident that in this field there will be many and startling developments before the Institution is a century old. To the question whether the suspension of scientific progress is conceivable, it might be replied that the advance of science is so inevitable that for all practical purposes we may regard it as one of the laws of life. The Institution's purpose, "the advancement of the sciences of engineering and shipbuilding", is a definite function of the organised form of society ruling to-day. The responsibility for the misuse or oversight of technical progress must be accepted by finance, commerce and the State, internationally. In the session just opening, the Institution, he said, would commemorate its jubilee, and he continued:

"I feel that if it were possible for those far-seeing men who founded this Institution to come amongst us to-day, they would consider that the great heritage which they left us has been fully preserved."

Training of Mercantile Marine Officers

SOME important recommendations for the better training of apprentices for sea service are contained in a report just issued by an Advisory Committee to the Manning Committee of the Shipping Federation. To qualify for the position of a junior officer in the British Mercantile Marine, it is necessary to serve an apprenticeship of four years, or three years if a boy has passed through the *Conway*, or *Worcester*, or Pangbourne College, and to pass the Board of Trade examination for second mate. At present, there is no recognised course of instruction or any uniformity in training for apprentices or cadets, and very often it is only with the greatest difficulty that apprentices prepare themselves for examination. Some shipping companies have special schemes of training; but such is not the general case. It is now proposed that a Central Board of Control should be set up with the power to draw up a standard syllabus of instruction, to set annual examination papers, to give practical advice to captains of ships in matters of education, to appoint local boards of examiners and to publish periodical statistics relating to the scheme of education. The Advisory Committee expresses its belief that, if shipowners adopt the scheme and give it their practical support, it will secure the sympathy and assistance of both the Board of Trade and the Board of Education. Apprentices at sea suffer from many disabilities as compared with their fellows ashore, and some recognised course of training such as is proposed has long been overdue. It is to be hoped, therefore, that the recommendations put forward will receive the support they deserve.

Research in the Automobile Industry

AT the annual dinner of the Institution of Automobile Engineers on October 12, Sir Herbert Austin referred to the debt the automobile industry owes to the Department of Scientific and Industrial Research; and the extent to which the industry receives help from the Department is dealt with in the recent annual report of the Research and Standardization Committee of the Institution. During the year ending June 30, 1934, the total income of the committee was £9,963, which included £5,000 from the Society of Motor Manufacturers and Traders, £1,962 from subscriptions and £2,500 from the Department. The year's expenditure on research was about £6,000. To stimulate further research, the Department has offered to increase its contribution to £5,000 if the industry will find £10,000, and to £10,000 if the industry will find £15,000. As the output of motor-cars in Great Britain was stated by Sir Frank Smith at the dinner to be 285,000 a year, it should not be difficult for the industry to find a sum which amounts to practically a shilling a car. Researches are already in hand on cylinder wear, valve seat wear, bearings, oil consumption, piston temperatures, brakes and other matters, and from these valuable information has been obtained.

Battery-Electric Cars

AFTER many years of almost suspended animation, the battery-electric vehicle industry is showing signs of life. At the Exide motor show, Mr. D. P. Dunne stated that the monthly output of these vehicles in Great Britain is larger than it has ever been before. Compared with petrol vehicles, they make less noise and produce less atmospheric pollution. Statistics prove that their life is much longer and their maintenance is much less than that of any other form of mechanically propelled road vehicle. Several corporations are using electric vans in connexion with their electrical apparatus hiring schemes. The West Ham undertaking has vans with a speed of 20 miles per hour and a range of 50 miles per charge. They use an electric motor coupled to the back-axle through differential gearing. The charging arrangements are quite simple: a 'jack' is provided on the dashboard for connecting with the mains and there is an automatic control to limit the rate of charging. This undertaking has introduced a night tariff of 0·66*d*. per unit for vehicle charging. In certain cases, such vehicles will prove more economical than petrol vans.

Investigation of Cosmic Rays by Sounding Balloons

ACCORDING to a recent article distributed by Science Service, Washington, D.C., Dr. Arthur H. Compton, of the University of Chicago, proposes to use small sounding balloons that will automatically send wireless signals recording pressure and temperature of the air and the intensity of the cosmic rays. The idea is not new, having been developed for example by Prof. J. M. Benade, of Lahore, and by Prof. Moltchanoff, of Leningrad (NATURE, Dec. 31, 1932, p. 1006). The risks attending direct exploration of the stratosphere are obvious, and these special balloons are designed to avoid them, while greatly reducing expense; they are said not to exceed 15 ft. in diameter at release, and to weigh only 16 lb. Radio signals are to be emitted from a single valve oscillator. The movements of a special barometer will affect the wave-length of the signals, and the signals will be interrupted by a balance wheel, of which the rate of oscillation will be controlled by temperature. They will also be interrupted at each discharge of a cosmic ray counter—an instrument which discharges at a rate dependent upon the conductivity of the atmosphere, which in turn is affected by the cosmic rays—the length of time between such breaks giving an indication of cosmic ray intensity just as the lengths of the intervals between interruptions previously mentioned will indicate the temperature. It is understood that Dr. Compton's measurements will not entirely replace those made with manned 'stratosphere balloons', but will supplement them and allow some information to be obtained from sparsely populated regions where neither manned balloons nor balloons that release self-recording instruments when they burst can be employed, in the first case

because of the risk of descent far from help and in the second because of the small hope of recovering the instruments.

New British Birds

THE addition of six birds new to the British list, and the alteration in nomenclature of another, has been agreed to by the council of the British Ornithologists' Union (*Ibis.*, July 1934); and no less than three of the new types are birds from South Uist, Outer Hebrides, where they were distinguished and described by Col. Meinertzhagen. The newly added species are: the Hebridean twite (*Æanthis flavirostris bensonorum*) which is darker and not so red as the common twite (*Linota* (*A.*) *f. flavirostris*) and with blacker centres to its feathers, the underparts being similar to the mainland birds; the Hebridean stonechat (*Saxicola torquata theresoe*), the female of which is not so red and darker above and below than the common stonechat (*Saxicola t. hibernas*), the black bases of her throat-feathers being more conspicuous—the male is slightly darker above, especially on the forehead, but with the underparts similar; the Hebridean hedge-sparrow (*Prunella modularis hebridium*) with general darker plumage than the common hedge-sparrow (*Accentor modularis occidentalis*), the flanks being more heavily marked and streaked, the upper parts richer and more distinctly marked and the grey on the throat darker. The types of these three birds were obtained from South Uist, the latter bird being the least common. The other additions are the Scandinavian jackdaw (*Corvus monedula monedula*) from a specimen obtained at Lowestoft and described as a migrant to the east coast of England; the arctic ringed-plover (*Charadrius hiaticula tundrae*), a well-established race distinguished from the common bird (*Ch. h.h.*) by its smaller size and darker colour, nesting in Lapland, Arctic Russia and Siberia, a specimen in the British Museum being from Poole Harbour, Sussex; and the bridled or lesser sooty tern (*Sterna anœthetus*) of the West Pacific and Indian Oceans, which has been obtained from Dungeness and a Thames lightship. The British song thrush has been altered from *Turdus philomelus clarkei* to *Turdus ericetorum ericetorum*, and correspondingly, the continental song thrush to *T. e. planiceps*, and the Hebridean song thrush to *T. e. hebridensis*.

High Wind Speed at Mount Washington

IN the *Engineering News-Record* of May 10, 1934, there is an article about the alleged wind speed of 231 miles an hour said to have been attained at the meteorological observatory of Harvard University on Mount Washington, New Hampshire, on April 12, 1934. Most meteorologists—at least European ones—probably paid little attention to the reports of this wind that appeared in the newspapers soon after that date, on the grounds that such a wind could not have been measured even if it actually occurred, but Dr. C. F. Brooks, professor of meteorology at Harvard, is quoted as stating that the speed in question was recorded by an anemometer of the cup pattern, similar in principle to the well-known Robinson anemometer, and is probably correct to within about ten miles an hour. It appears that the design of the instrument was roughly copied from an experimental anemometer seen at Bergen in 1931, modifications being introduced to meet the difficult conditions sometimes experienced at Mount Washington, in very windy weather, that may result in massive ice formations due to rime. Electrical heating of the anemometer of a very powerful kind had to be introduced, and hot air was made to pass through the six cups, which were fitted closely round a copper disc placed over an electric stove, and were driven in the normal manner by the pressure of the wind. The instrument was tested in a wind tunnel at the Bureau of Standards up to a speed of 150 miles an hour, and as the calibration curve became nearly straight towards the maximum speeds it seemed justifiable to extrapolate to 231 miles an hour, with the probability of obtaining a figure not significantly different from the true figure. The speed in question was the average, while three contacts were made, each representing the passage of 1/30 mile of air past the cups and was therefore for a gust.

Forestry in Trinidad and Tobago

THE annual report of the Forest Department of Trinidad and Tobago, 1933, has recently been published (Govt. Printer, Port of Spain, Trinidad, 1934). The satisfactory lines upon which the Department has been working, with the active support of the Government, is evident. The Government has obviously placed implicit trust in its Conservator, Capt. R. C. Marshall, who, after eleven years in the colony, is now taking up the post of conservator of forests in the Gold Coast. The acting conservator, the writer of the present report, seizes the opportunity of taking stock, in an introduction, of the progress made by the Department during Capt. Marshall's tenure of the post. This review covers all the branches of forest activity and is well worth reading. Progress in sylviculture has been considerable, but there are problems connected with the cedar which have yet to be solved. Most of the Colonial services are as yet so backward in the working plans branch of forestry that it is of interest to read that outline working plans or working schemes have been prepared for an area of approximately 90,000 acres of reserves. Under finance, the acting conservator shows that the surplus of revenue over expenditure for the eleven-year period, exclusive of free timber supplied to the P.W. Department (an iniquitous practice since, as a former Governor-General of India expressed it, Government is in effect taking free from the State forests materials for which the public has to pay), amounted to £51,017; revenue fluctuated from £25,054 in 1927 to £8,466 in 1931. The writer continues: "The Forest Department has repeatedly emphasized in its Annual Reports that the higher revenues are liable to be unstable, much of them being due to the clearing activities of Oil Companies, and that the Department's endeavours in this direction are primarily concentrated on obtaining a stable

revenue by supplying the Colony's ordinary wood-consuming industries with local timber. Some of this high revenue is in reality trust capital and strictly speaking ought to be treated as such."

Nature Protection in Poland

DURING its spring session, the Parliament of Poland discussed and passed a new law for the protection of Nature, a comprehensive measure covering many objects (*Kwartalny Biuletyn Informacyjny*, 4; 1934). The threat of the erection of tourist mountain railways on the Polish, as well as on the Czechoslovakian, side of the Tatras has aroused much concern and opposition, for it would interfere with the object, which seemed to be on the point of fulfilment, of creating a grand Tatras National Park jointly cared for by Poland and Czechoslovakia. In the eastern Carpathians, there has been created by the Metropolitan of the Greek-Catholic Church, a new Nature reserve, interesting because it protects a fine forest of Cembro pines (*Pinus Cembra*) growing upon the summit of Mount Jajko. Indeed the protection of ancient trees is one of the features of the Polish scheme, and one of the most remarkable grows in the village of Harbutowice in the west Carpathians —the oldest yew in the country, having a circumference of 2·80 metres. An excellent step has been taken in enlisting the co-operation of the school authorities in the Cracow and other districts; and with the object of familiarising school teachers with the objects and methods of Nature protection, special conferences have been held at which discussions have taken place on the feeding of birds in winter, and on the plants specially protected in the school districts. Another step, which might well be copied in Great Britain, is the agreement come to with the Polish radio authorities arranging that talks will be broadcast once a month on different aspects of the protection of Nature.

Activities of the Post Office

THE last annual report of the Post Office was issued nearly twenty years ago. Since then, there have been many radical changes and important developments in the work of this Government department which are not yet well known. We therefore welcome "The Post Office, 1934" (London: G.P.O. 1*s*.) which has just been published. In the preface the Postmaster-General reviews some of the developments, and he may indeed be proud of his department, which has kept well abreast of all the latest scientific advances. Owing to the competition of telephony, the traffic handled by the telegraph service shows a considerable falling off, but the rapid and revolutionary changes introduced are checking this decline. The teleprinter is now the standard machine in use in Britain; Morse signalling is rarely used. A motor-cycle service has quickened delivery, and incoming liners are met by telegraph representatives. As an experiment, boy messengers are attending a few of the main railway stations to accept telegrams from outgoing passengers. Up to twenty years ago, the telegraph was the only means of communication with foreign countries; now a telephone subscriber in Great Britain can communicate with 95 per cent of the telephone subscribers of the world. Wonderful progress has been made with radio services. For broadcasting, unfortunately, the wave-length position in Europe is very difficult owing to the fact that there are far more broadcasting stations than there are wave-lengths available for their use. Some countries were not satisfied with the allocation of wave-lengths made at the Lucerne Conference and are using waves contrary to the Lucerne plan.

Electricity Development in France

THE aim of electrical engineers in France is to create a huge network of high-voltage transmission lines which will connect the generating stations with the great centres of consumption. The systems of transmission are being standardised. For the high-tension lines, 220 and 150 kilovolts are being used, and secondary pressures of 90 and 60 are employed. This compares with the 132 kilovolts used in the British Grid. A report issued by the Department of Overseas Trade on "Economic Conditions in France" by Sir Robert Cahill (London: H.M. Stationery Office, 7*s*. net) gives much instructive information on this subject. It is stated that the production and distribution of electricity in France provide employment for 150,000 workers. The yearly output has been estimated at about one twentieth of the total world output. There are 1,200 companies producing or distributing electricity, and the productive capacity of the stations increased very rapidly before the commercial depression and is still increasing. The output of the great thermal stations of the coal-mining, metallurgical and industrial areas, north and east of Paris, and in the vicinity of Lyons, will form in a few years' time part of a comprehensive electrical supply system, so that any temporary breakdown in the supply from one station can be made good from the others. The output of the thermal is double that of the hydro-electric stations. There still remains about 60 per cent of the maximum possible water-power not utilised. The Rhine development scheme includes the erection of eight large power stations at intervals along the river. The first, which is already in operation, is at Kembs, about ten miles below Basle, and is equipped to produce nearly 200,000 kilowatts. The combined power of the eight stations will be 650,000 kilowatts. Various schemes have been proposed and stations built for utilising tidal power on the coast of Brittany, but so far none of them seems to have been commercially successful.

Social Insurance

THE importance of demographic considerations in relation to social problems are stressed by Prof. J. P. Dalton in a pamphlet on "Social Insurance" recently published by the University of the Witwatersrand Press, Johannesburg. The author claims that the demographic consequences of social processes are in the long run of paramount importance, though they are usually ignored or ill-understood. He argues

that unemployment insurance can do no more than offer a temporary palliative, and that the experience of England and Germany shows all too clearly the limitations from which it suffers. Likewise public works, though necessary to relieve immediate distress, are of but temporary advantage. This is true even of the multiplication of resources provided by schemes of such magnitude as the draining of the Pontine Marshes or the reclamation of the Zuider Zee. The fundamental problem is to secure a stable balance between production, consumption and population. In this connexion, the biological ageing of a population must necessarily have economic repercussions, European South Africa is still demographically some twenty-five years behind England, but South Africa is also ageing. He suggests as a solution for South Africa's problems, a vigorous policy of immigration, and points out that so long as America keeps an open door, her unemployment difficulties are not very serious. There remains, he adds, an alternative way of controlling the contraction of South Africa's market, and that is by enhancing the purchasing-power of the non-European population.

Cultivation of Onions

A NEW bulletin (No. 69) recently issued by the Ministry of Agriculture (H.M. Stationery Office, 1*s.*) deals with onions and related crops. Considering that more than 90 per cent of the onions consumed in Great Britain are purchased from abroad at an annual cost of nearly 2 million pounds, it is evident that this is an instance of a crop which could with advantage be much more extensively grown in this country. The acreage devoted to onion growing in England and Wales has seriously declined since 1913, the reduction in some instances amounting to 50 or even 75 per cent. The soil in many parts of the country is eminently suited to the crop, and although a certain degree of skill is required in cultivation, manuring, harvesting and storing, there seems no reason why onion production should not be substantially increased. Besides the wealth of practical information provided in the bulletin, interesting comparisons are drawn between the methods of cultivation employed in the principal onion-growing countries such as Spain, Holland, Egypt and the United States, and the respective seasons at which their produce is imported into Great Britain.

Air-Speed Record

IT is announced by the Milan correspondent of the *Times* that Warrant Officer Francesco Agello, flying at Desenzano, on Lake Garda, on October 23, attained an average speed of 709·202 kilometres (440·67 miles) an hour, and a maximum speed on one run of 711 kilometres (441·22 miles) an hour. Agello was flying a Macchi-Castoldi 72 seaplane with a Fiat engine similar to that in which he set up a record on April 10 last year of 682·4 kilometres an hour.

Announcements

WE regret to announce the death of Prof. Santiago Ramón y Cajal, For.Mem.R.S., professor of histology and pathological anatomy in the University of Madrid, on October 18, at the age of eighty-two years.

A DISCUSSION on the John Murray Expedition will be held at the Royal Society on November 1 at 4.30, to be opened by Lieut.-Col. R. B. Seymour Sewell. Preliminary accounts of the work of the Expedition have appeared in NATURE of January 20, p. 86, and May 5, p. 669.

IT is announced that Mr. J. M. Edmonds has been appointed geologist on the staff of the Geological Survey, Khartoum, Anglo-Egyptian Sudan.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 22, the following officers were elected: *President:* Prof. D'Arcy W. Thompson; *Vice-Presidents:* Sir Thomas Holland, Prof. C. G. Darwin, Prof. R. A. Sampson, Principal O. Charnock Bradley, Prof. P. T. Herring, the Marquis of Linlithgow; *General Secretary:* Prof. J. H. Ashworth; *Secretaries to Ordinary Meetings:* Prof. F. A. E. Crew and Prof. J. P. Kendall; *Treasurer:* Dr. James Watt; *Curator of Library and Museum:* Dr. Leonard Dobbin.

THE beautifully illustrated and printed *Natur und Volk*, published in Frankfurt, is mainly for popular reading. The August number contains, in addition to botanical and geological articles, papers on the work of Canadian beavers and on abnormalities in the teeth of rodents, both informative and with good photographs.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics at the Borough Polytechnic, Borough Road, London, S.E.1—The Principal (Nov. 1). A headmaster of the Junior Technical School, Acton Technical College—The Secretary, 10 Great George Street, Westminster, S.W.1 (Nov. 3). A director of the New Art Gallery and Museum, Perth—The Town Clerk, City Chambers, Perth (Nov. 3). An examiner in the Aeronautical Inspection Directorate—The Secretary (S.2), Air Ministry, Adastral House, Kingsway, W.C.2 (Nov. 5). An assistant professor of gunnery and mathematics at the Military College of Science, Red Barracks, Woolwich, S.E.18 (Nov. 12). A director of research at the Wool Industries Research Association, Torridon, Headingley, Leeds, 6—The Secretary (Nov. 15). A physiologist at the Marine Biological Laboratory, Plymouth—The Director (Nov. 19). A professor of modern experimental physics at the National Central University, Nanking, and a professor of hydraulic engineering at the National Chekiang University, Hangchow, China—The Universities China Committee, 91, Gower Street, W.C.1. An advisory entomologist at the Harper Adams Agricultural College, Newport, Shropshire—The Principal. Two assistants in the Directorate of Technical Development, Royal Aircraft Establishment, South Farnborough, Hants.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Relation between Temperature and Radius in the Cepheid Variables

The most important objection raised against the pulsation theory of Cepheid variation lies in its failure to explain the observed phase relation between temperature and radial velocity. In a pulsating star it would appear that maximum temperature and luminosity should coincide in phase with minimum radius. Actually, however, observations of radial velocity show that at maximum light the stellar atmosphere possesses its greatest velocity of approach towards the observer. Eddington has shown that this phase-displacement cannot be explained as due to a lag of energy-flow introduced in the upper, non-adiabatic, layers of the star.

A possible explanation of the phenomenon, however, is that the observed radial velocity, measured as it is from the displacement of absorption lines in the stellar spectrum, is not an index of the radial pulsations of the star as a whole, but that the oscillations of the stellar atmosphere differ in phase by approximately one quarter of a period from the pulsation of the body of the star.

In this case, measurements of radial velocity variation will give an incorrect picture of the radial pulsations, and the stellar radius, that is, the radius of the photosphere, must be determined throughout the light cycle by some other means. The interferometer is at present incapable of producing results of the required accuracy, and more doubtful methods must be employed.

On the assumption that these stars radiate approximately as black bodies, their temperatures and bolometric luminosities can be determined at various phases from the visual and photographic light-curves. The material available for this purpose is extremely scanty, mainly on account of the lack of continued observations based on a standard magnitude sequence. But one extended series of standardised observations was available to me; namely, that on RS Bootis, due to Seares and Shapley[1]. From these observations of magnitude and colour index, the bolometric magnitude B, the temperature T, and the radius R have been computed for different phases over the entire light-curve. A harmonic analysis of the resulting curves over a light-cycle gives the following results:

$$B = 10{\cdot}33^{\mathrm{m}} + 0{\cdot}53^{\mathrm{m}} \cos(v - 246^\circ) + 0{\cdot}26^{\mathrm{m}} \cos(2v - 270^\circ) + 0{\cdot}20^{\mathrm{m}} \cos(3v - 281^\circ)$$

$$T = 7{,}900^\circ + 2{,}080^\circ \cos(v - 71^\circ) + 1{,}130 \cos(2v - 96^\circ) + 950^\circ \cos(3v - 106^\circ)$$

$$R = 0{\cdot}148 + 0{\cdot}033 \cos(v - 256^\circ) + 0{\cdot}019 \cos(2v - 281) + 0{\cdot}010 \cos(3v - 288^\circ)$$

It appears, therefore, that maximum temperature and luminosity and minimum photospheric radius nearly coincide in phase.

A further result leading to the same conclusion is that in this star the temperature and radius throughout the cycle satisfy closely the relation

$$R.T = \text{constant},$$
$$\log RT = -5{\cdot}95 \pm 0{\cdot}01.$$

This result has been tested for a number of stars for which the available data are not so complete, and appears to hold, with a larger degree of scattering. The maximum probable error of the mean value of log RT for any group of observations was found to be eight per cent.

The conclusion of the pulsation theory, therefore, that maximum temperature and minimum radius should coincide, is borne out by the available material. The behaviour of the atmosphere is a problem that still requires theoretical investigation. The relation between radius and temperature found above has not been explained, but further work is being undertaken in this connexion, particularly in the light of the recent paper by Prof. Milne[2].

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[1] Seares and Shapley, *Astrophys. J.*, **48**, 214; 1918.
[2] Milne, *Mon. Not. Roy. Astro. Soc.*, **94**, 418; 1934.

Preparation of Protium Oxide and Determination of the Proportion of Deuterium in the Hydrogen of Normal Water

We have recently prepared specimens of highly purified water almost free from deuterium and have compared their densities with that of similarly purified, ordinary water. The preparations were effected by electrolysis, by the decomposition of water with metals, and also, partly, by fractional distillation.

The relative densities were determined by a float method, which allows comparisons to be made with an accuracy of about 1 part in 10^7. Of the specimens of water examined, that which has the lowest density should contain at the most a few units per cent of the original deuterium: it is nearly pure 'light water', or protium oxide. It proves to be lighter than purified London and Leeds tap-water by 12 parts per million at 20° C. Our samples of purified London and Leeds tap-water have an identical density, which was made the standard of the comparisons.

From this value and Taylor and Selwood's determination of the density of deuterium oxide, we calculate that the molecular proportion of heavy water in our standard water is 1 in about 9,000; that is to say, there are about 110 atoms of deuterium per million in the hydrogen of the standard water. This proportion is considerably smaller than is usually assumed: it is possible that the further experiments now in progress may cause some increase, but any large change seems unlikely.

Accepting this value provisionally as a lower limit, it is of interest to calculate from Aston's measurements the chemical atomic weight of normal hydrogen. For H^1 Aston has obtained the value 1·00778 on the scale $O^{16} = 16$. Using our value, the atomic weight of normal hydrogen should be 1·00789 on the same scale. Corrected to the chemical scale by means of Mecke and Childs' factor, this becomes 1·00767, whilst if Babcock and Naudé's factor is employed the value obtained is 1·00777. The most probable value as calculated from chemical data is given by Birge as 1·00777, but it is doubtful whether the ratio H : O has ever been determined using gases of normal isotopic composition.

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Cause of Changes in Rate of some Gas Reactions

IN 1932 Travers and Hockin described a phenomenon associated with the formation of methane and of condensation products during the pyrolysis of pure ethane[1]. When this gas is heated to the neighbourhood of 600°, ethylene and hydrogen are formed very rapidly, and a state is approached rapidly approximating to equilibrium in the ethane-ethylene-hydrogen system. Methane and condensation products are also formed, and as Travers and Pearce show in a paper which will shortly appear in the *Transactions of the Society of Chemical Industry*, both processes originate independently from the ethylene. When the pyrolysis has proceeded for a short time, the rates of formation of methane and of condensate suddenly and simultaneously slow down. However, if instead of using pure ethane, a mixture of ethane, ethylene and hydrogen in equilibrium proportions is used, no breaks are observed in the graphs representing the rates of formation of methane and condensate at all. The initial rate of both processes is definitely greater when starting from pure ethane than when starting from an equilibrium mixture, and while in the former case the processes are markedly affected by surface, in the latter the effect of surface appears to be negligible.

In the paper now in the press, Travers and Pearce explain the phenomenon in the following way. The energy of activation of the primary decomposition of ethane into ethylene and hydrogen is about 76 k.cal. while the energy requirements of the process are about 31 k.cal. As a consequence, the energy to be disposed of is 45 k.cal. The result is that, superimposed upon the process by which methane and condensate are formed in equilibrium mixtures, there is, in the case of the initial stages of the pyrolysis of pure ethane, an energy chain mechanism, which continues up to a point which is possibly determined by the formation of condensation products of high molecular weight, of which the rate is determined by surface conditions. However, the cause of the whole phenomenon is to be found in the existence of the reaction involving the primary decomposition of the ethane. This is what is referred to in this laboratory as a *background process*, and on such background processes identical phenomena in the case of other reactions appear to depend.

In the course of the discussion at the Royal Society on May 10, we described some experiments which were being carried out in this laboratory on the thermal decomposition of acetaldehyde, which indicated that a similar phenomenon occurred in this case. Attention was directed to the fact, because it seemed to have some bearing on a phenomenon observed by Mr. Hinshelwood[2] in an investigation on the thermal decomposition of the same compound, to which he has made reference in several papers. Mr. Hinshelwood, in commenting on our note[3], denied that there was any connexion between our observations and his own, but we find it difficult to see wherein the difference lies. However, we feel very sure that the following facts cannot be ignored.

One cannot consider the pyrolysis of acetaldehyde without taking careful account of the experimental work of Prof. W. A. Bone[4] on the occurrence of this compound and its isomers, among the products of oxidation of ethylene, or avoid the possibility that internal change such as,

Acetaldehyde = Vinyl alcohol,

may constitute a *background reaction* such as operates in the early stages of the pyrolysis of pure ethane. In this case, the system may be a much more complex one than that which we have to consider in the case of ethane, which may account for the facts put forward in our contribution to the discussion of May 10. It does not seem to be at all unlikely that the formation of methane and carbon monoxide from acetaldehyde involves the previous formation of vinyl alcohol, and that the mechanism of the subsequent reaction is similar to that which Travers and Pearce have suggested for the formation of methane and condensation products from pure ethane.

In the case of the thermal decomposition of dimethyl ether, we have a process operating in two stages. In the first stage methane and formaldehyde are formed, the rate of the reaction being measured by the rate of formation of methane. There are no breaks in the graphs representing this process, which is in accord with the view which is now put forward, for there is no obvious background process. The second stage, the decomposition of the formaldehyde, which can be followed separately when using our analytical method of investigation, exhibits the phenomenon which we have described. The background process is most probably the process of primary decomposition of the dimethyl ether.

Finally, we must refer to an investigation on the hydrogenation of diphenyl to benzene which was carried out in this laboratory by Dr. J. E. Sisson. In this case, breaks which occur in the graphs representing the rate of formation of benzene appear to be related to maxima in the concentration of diphenyl-benzene, which is formed during the process of hydrogenation by a process which does not appear to be a simple one, and may act as a background reaction to the hydrogenation process.

It seems possible that reactions involving the thermal decomposition of organic substances fall into two classes. In one of these, in the early stages, an energy chain system is imposed upon a simpler process, the energy chains being initiated by some *background process*, tending towards equilibrium in the system. In the other class such a background process does not operate, and the main process is of a simpler character. However, even in such processes the products of reaction may still influence activation, as indicated in our contribution to the discussion on May 10, and developed in the paper by Travers and Pearce to which reference has been made.

We are continuing the investigations on acetaldehyde and dimethyl ether by the method of detailed analysis which has been described elsewhere. Though exact, the method is laborious and the work takes a long time.

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Sept. 29.

[1] *Proc. Roy. Soc.*, A, **136**, 1 ; 1932.
[2] NATURE, **131**, 24, Jan. 7, 1933.
[3] *Proc. Roy. Soc.*, A, **146**, 252 ; 1934.
[4] *Proc. Roy. Soc.*, A, **143**, 16 ; 1933.

Spectra and Latent Energy in Flame Gases

AFTER flame has travelled through an inflammable gaseous mixture the gases remaining are not merely hot CO_2, etc. They emit luminous radiation for a long time (if their temperature is kept up), their temperatures as determined by the sodium line reversal method are too high, and they have associated with them a long-lived latent energy which amounts to a considerable proportion of the heat of combustion. The evidence for this has been summarised in a recent article in the *Engineer*[1].

The spectral examination of the after-glow of CO_2 after excitation in a vacuum tube, and of CO-flames, by Prof. Fowler and Mr. Gaydon[2] suggests that during combustion CO_2 molecules are formed of a type similar to those responsible for the after-glow. It is conceivable that the latent energy in flame gases may be associated with metastable CO_2 and H_2O molecules, or it may be that it results from a dissociation of these molecules in a manner quantitatively widely different from that of ordinary thermal dissociation.

In the case of CO-air combustion we have found that the latent energy is much greater in constant pressure combustion than in closed vessel explosions. To take a typical example, in a particular mixture burning at 5 atmospheres the latent energy is 15 per cent of the heat of combustion, whereas when this mixture is exploded in a large closed vessel at such initial pressure that the explosion pressure is 5 atmospheres, it is only about 5 per cent (and would only have been about half of this had the initial pressure been 5 atmospheres).

An interesting correlation with flame and explosion spectra may be made. Prof. Bone and his co-workers have shown that there is a "marked shortening in the ultra-violet" in CO-explosion spectrograms when compared with those from ordinary CO-flames[3]. It would thus seem that the greater the latent energy in the CO-flame gases the greater the relative intensity of the ultra-violet radiation; and this suggestion is further supported by a comparison of Prof. Bone's spectrograms with our latent energy determinations in the constant pressure burning of pure CO-mixtures at various pressures.

As will be clear, however, from the typical example given above, there appears to be some essential difference between combustion in CO-explosions in a large vessel and in CO-flames. It would be of interest to take spectrograms of the after-glow from the flame gases left behind the flame front as it travels through a long tube filled with CO-mixtures. It seems possible that, whereas after the uniform slow movement the spectrogram would be of the ordinary flame type, its character may change to that of the explosion type when nearing detonation.

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Oct. 2.

[1] "Temperature and Latent Energy in Flame Gases", *Engineer*, June 1, 1934.
[2] *Proc. Roy. Soc.*, A, **142**, 362; 1933.
[3] "Gaseous Combustion at High Pressures". Bone, Newitt and Townend. (Longmans, 1929.) Pp. 196.

Lunar Periodicity in the Conjugation of *Conchophthirius lamellidens* Ghosh.

THE ciliate *Conchophthirius lamellidens*, living as an ectoparasite on the gills of a fresh-water mussel *Lamellidens marginalis* Lamarck, has been under our observation for nearly two years. The specimens were collected from ponds in Calcutta. We had seen conjugation in this ciliate from time to time, but it was not until September 1933 that we started keeping proper records in order to determine the frequency of occurrence of this process. Our method of procedure has been to examine four mussels every day and search the gill scrapings for conjugants.

The accompanying diagram (Fig. 1) on which we have plotted the average number of conjugants against the day on which they occurred during six months, together with the maximum and minimum air temperatures for those months in Calcutta, is self-explanatory. It clearly shows that the number of

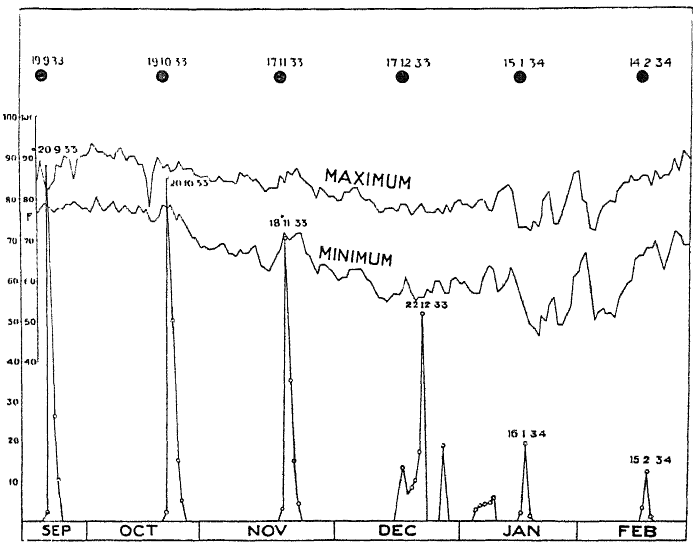

FIG. 1. Lunar periodicity in conjugation of *C. lamellidens*. Ordinates show average number of conjugants.

conjugants for the month has usually been highest on the day following the new moon. In the month of December the peak was shifted by five days. In this month the temperature graphs show the arrival of the first cold wave of the season (though mild) a few days before the new moon. This appears to be not only responsible for shifting the anticipated date from December 18 to 22, but also for making the process linger over a number of days. The 'slackers', therefore, were in evidence even up to January 8, 1934. The data for March were just available at the time of writing. The arrival of an unusual cold wave about the middle of the month appears to have retarded the process so much that only one pair of conjugants was seen on the date anticipated, namely, March 16.

The graph suggests that (*a*) normally the peak occurs on the day following the new moon if there are no disturbing factors, of which the air temperature fluctuations is an important one; (*b*) the number of conjugants simulates the annual variation of the air temperature. That the air temperature and its oscillations do exercise a controlling effect on the number of conjugants in a month is apparent from

the graph, but the lunar periodicity also appears to be an independent factor.

We expect to publish the details of our investigation elsewhere.

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The Sucking Apparatus in Ticks

THE mouth-parts hitherto recognised in ticks comprise a hypostome and a pair of cheliceræ, the three together forming what is believed to be the piercing and sucking organ. The actual mouth-opening, however, has never been observed.

In the course of my studies upon the anatomy of *Ornithodorus papillipes*, Birula (= *O. crossi*, Brumpt), I was successful in differentiating a stylet overlying the dorsal gutter of the hypostome. On following it up by careful manipulation, it proved to be the tubular continuation of the pharynx, the intervening buccal chamber being entirely separate from the surrounding exo-skeleton, except for the connective tissues and chitinous plates interposed between the walls of the two. Furthermore, the entire structure, from the proximal end of the pharynx to the distal point of the stylet, could be lifted out of the surrounding debris and mounted on a slide after due dehydration.

The stylet is resistant to the action of caustic potash and is undoubtedly the homologue of the hypopharynx in other blood-sucking arthropods. It is remarkably refractile and can scarcely be recognised in opaque specimens. It is provided with a clearly visible lumen and a distal orifice, and that it represents the true sucking apparatus in ticks is evidenced by the fact that in one instance at least the walls of the lumen, together with the inside walls of the buccal chamber and pharynx, were found scattered over with particles of blood. The extremely refractile character of the stylet doubtless accounts for the fact that it has escaped the observation of other workers on the subject.

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Sept. 21.

Unique Structure in the Adrenal of the Female Opossum

THE cortex of the adrenal of the Australian opossum (*Trichosurus vulpecula*) cannot be divided into the typical zona glomerulosa, zona fasciculata, and zona reticularis of Arnold (1866). Completely surrounding the medulla is a thin rim of cortex in which there is no zona glomerulosa, and which is divided into an outer zone containing fat, fatty acids, lipoids, cholesterol, etc., and an inner, practically lipoid and fat-free, zone. These two zones are to be described as the 'alpha' and 'beta' zones. Scattered amongst the cells of the 'beta' zone are cells with oval nuclei which contain a number of unusually large karyosomes; these cells have an unknown function and are to be called 'gamma cells'.

In the male opossum the adrenal possesses but a thin cortex made up of 'alpha' and 'beta' zones. In the virgin female there are the beginnings of hypertrophy of the 'beta' zone on one side of the gland, which pushes into the medulla. This hypertrophy continues to maturity. At maturity the 'beta' zone cells nearest the medulla commence to change from the small, compact cell with relatively large, deeply staining nucleus and scanty, rather neutophilic cytoplasm to a cell with at least four times as much cytoplasm which stains homogeneously with eosin, and with a slightly larger, more vesicular, and lightly staining nucleus. From the medulla towards the cortex, the 'beta' cells become transformed into these new cells and build up a zone which stands out from the rest of the gland as an eosinophilic zone, and is to be described as the 'delta' zone.

At early pregnancy, there is a slight decrease in the size of the 'delta' zone (compared with the size of the gland) but the 'beta' zone (also compared with the size of the gland) remains the same. At mid-pregnancy the 'beta' zone has nearly doubled its breadth and the 'delta' zone has increased considerably. At late pregnancy the 'beta' zone has grown until it occupies more than three quarters of the hypertrophied area. In a female in which a recent parturition had occurred, half the 'beta' zone had been transformed into 'delta' zone cells again. In a female suckling a small pouch young, the 'delta' cells of the hypertrophied area had been entirely replaced by 'beta' cells, and as the suckling continued nearly all these metamorphosed into 'delta' cells. The hypertrophied area at this stage is larger, relative to the size of the gland, than at any other stage. During the remainder of the suckling the hypertrophied area continued to grow 'beta' cells which eventually became changed into 'delta' cells, were destroyed and replaced by fresh 'beta' cells and so on. Although the sizes of the adult glands, and therefore of the hypertrophied area, vary considerably in different specimens, the size of the hypertrophied area expressed as a percentage of the size of the gland is practically constant in adult females.

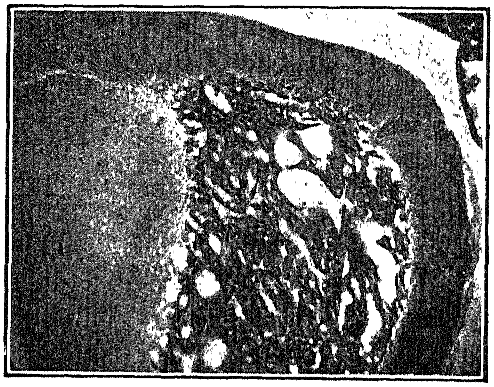

FIG. 1. Section through adrenal of female of *Trichosurus vulpecula* showing hypertrophied zone extending into the medulla.

It is difficult to explain why the 'beta' zone, which extends completely around the medulla, hypertrophies and produces 'delta' cells only on one side (Fig. 1). There is a true zona reticularis connecting the 'delta' zone and the remainder of the cortex to the medulla.

The function of this hypertrophied area is quite unknown. The 'delta' zone contains a small amount of argentophile material, which is probably vitamin C, when subjected to techniques which I have described in various communications. It contains only an occasional droplet of lipoidal material and no cholesterol, fatty acids or fats as shown by various

histological techniques. The 'beta' zone contains slightly more lipoid and rather more vitamin C, but these materials and the fats, etc., are concentrated chiefly in a very thin peripheral cortical rim—the 'alpha' zone.

The 'beta' zone, and more rarely the 'delta' zone, may be stained bright yellow due to the diffusion through the cytoplasm of a lipochrome pigment, presumably a carotene. The occurrence of this pigment bears no relation to the reproductive cycle. At times, masses of lipochrome may be seen in the vascular clefts of the cortex and in the medullary sinuses. The latter are sometimes crammed with these masses. The cells of the zona reticularis are invariably packed with lipochrome in the form of globules of various sizes. The pigment is present in the glands of male and female animals. The 'delta' zone, as is to be expected, occasionally contains quantities of a black pigment which appears to be melanin.

It is impossible to observe the striking association of this pigment (presumably a carotene) with the adrenal of the opossum without coming to the conclusion that the adrenal must play an important rôle in the vitamin A metabolism in this animal.

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Alleged Stimulation of Moulds by Paraffin in Heavy Water

IN a recent communication, Klar[1] has questioned the results of experiments which seem to indicate that diplogen exerts a stimulative effect. He would attribute any such increase in growth as has been noted to the presence of organic impurity rather than to the heavy isotope of hydrogen. The investigations of Barnes[2], Barnes and Larson[3], Richards[4], and Meyer[5] have shown that such stimulation does occur and it has been attributed to the presence of the D atom. I was aware that there was a certain amount of inorganic, and possibly organic, impurity in the 'Ohio'-water used, approximately 0·04 per cent or less, but am of the opinion that the method of purification by a careful double- and triple-distillation in pyrex glassware removed any such impurity. The investigations reported here seem to substantiate this view.

After the double distillation of the 'Ohio'-water used in the experiments with *Aspergillus* sp., there was no detectable odour and the water had the 'flat' taste which is so characteristic of distilled H_2O. Approximately 25 c.c. of the 0·5 per cent deuterium oxide, twice-distilled, in each of four 125 c.c. Erlenmeyer flasks, left freely exposed in the laboratory for a period of 44 days, showed no growth of mould of any kind, whereas a solution of Pfeffer's three-salt and sucrose medium showed a heavy fungus growth within a week. If the organic impurity suggested by Klar were present in the heavy water, it was neither of a kind nor in sufficient quantity to serve as a nutrient for the growth of mould. Furthermore, the solution in which the *Aspergillus* sp. was grown, in the investigations reported, was Pfeffer's three-salt medium with sucrose as the source of carbon, a full nutrient solution for the growth of the fungus. There was much more available organic compound present than the plants could possibly use in the five-day growth period. It seems exceedingly unlikely that this suggested organic impurity, if present, would have exerted so profound a stimulative effect in a medium already rich in available organic material.

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[2] Barnes, *J. Amer. Chem. Soc.*, **55**, 4332; 1933. *Amer J. Bot.*, **20**, 679; 1933. *Science*, **79**, 370; 1934.
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[4] Richards, *Amer. J. Bot.*, **20**, 679; 1933. *J. Bact.*, **28**, 289; 1934.
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Titration of Protein with Trichloroacetic Acid

In a paper to the recent Faraday Society discussion on colloidal electrolytes, one of us (R. K. S.) pointed out that some of the difficulties encountered in the acid titration of proteins would be overcome by using an acid of which the anions become firmly bound to the positive groups of the protein. As a particular case, metaphosphoric acid was cited, the powerful coagulating power of which makes it a simple matter, after adding an excess of acid, to extract an aliquot free from protein for back titration.

We have just completed some preliminary trials with trichloroacetic acid, and find that edestine added to a 0·1 molar solution of this acid at the rate of about one gram per 100 c.c. and centrifuged, gives a clear liquid which contains only a trace of the added nitrogen and can be back-titrated to a sharp end-point. Similar results are obtained with the mixed proteins of wheat flour. The acid binding capacity of edestine determined in this way is in good agreement with published figures.

Trichloroacetic acid appears, therefore, to be a valuable reagent not only for the precipitation of protein, for which purpose its use in solutions of 10 per cent and upwards is already recognised, but also, when more dilute, for the rapid estimation of titratable amino-groups. Ordinary meta (glacial) phosphoric acid is a mixture of a number of acids of general formula $(HPO_3)_n$, some of which are therefore polybasic. This introduces difficulties both in the back-titration and also in the interpretation of the results, so that this acid will probably prove to be less generally useful than trichloroacetic. The matter is being further investigated.

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The Lobster, *Enoplometopus occidentalis*, Randall, in South Africa

RECENTLY Mr. E. C. Chubb, curator of the Durban Museum, sent for identification a very fine specimen of the above species. First recorded from Honolulu, the records of its occurrence have been proceeding westwards: Reunion (Milne Edwards), East Indies (de Man), and Mauritius (Bouvier). Its presence on the Natal coast is therefore not unexpected, but nevertheless interesting and worthy of record.

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Research Items

Prehistory of Indo-Iranian Borderlands. A report of the Huxley Memorial Lecture of the Royal Anthropological Institute, delivered by Sir Aurel Stein during the session of the First International Congress of Anthropological and Ethnological Sciences on July 31, appears in *Man* for September. The subject matter of the lecture was gathered on five journeys between 1927 and 1934 in British Baluchistan, Makran and Fars, the ancient Persis. The plentiful remains of the chalcolithic and later periods, in an area inadequately explored archæologically, provide links with the earliest civilisations of Mesopotamia and Elam on one hand and with the Indus valley on the other. Great ethnic movements have passed across these areas and penetrated India; and their effects are felt down to the present day. Prehistoric settlements are to be traced west of the Indus at a great line of mounds stretching along the barren foot of the south-western Waziristan hills. Their size suggests climatic conditions more favourable to settlement than those of the present day. In considering the probable line of migration of the Aryan tribes speaking Vedic Sanskrit, who conquered the Punjab about the second millennium B.C., attention is directed to the tribes worshipping Vedic divinities and apparently speaking a Sanskrit language, who are mentioned in Hittite inscriptions of the seventeenth century B.C. as leading a pastoral life in the Mitanni country roughly located in Kurdistan. Both archæology and history fail to throw any light on the great movement of Aryan conquest, which may be supposed to have started from this area; but geographical considerations suggest that it is likely to have passed south of the great belt of central Persian deserts to the northern portion of Persian Baluchistan and the Helman basin.

Social Life in Ancient India. Incidental references, mainly in a Pali commentary known as the *Vimānavatthuatthakathā*, throwing light on social observances in Ancient India have recently been collected by Kalipada Mitra (*J. and Proc. Asiatic Soc. Bengal*, N.S., 29, No. 1). Festivals hold a prominent place. A description of the necessary preparations for such festivals says that the citizens had the streets swept clean, and sprinkled on them sand and five kinds of parched rice and flowers. At the door of every house, banana plants and full pitchers were placed. According to their means they caused flags and streamers of many colours to flutter. All the people attired themselves in their best robes. The king came out with a great retinue and in magnificence to make a circuit of the city—apparently a usual practice. The festivals, however, were only for those who could afford them; the poor did not take part or interrupt their work. Players, dancers, rope-dancers, wrestlers, boxers, jesters, story-tellers and others of like occupation were present in large numbers. On the 'Public Day Festival', families, who do not ordinarily go out, come forth to go unclothed to the river to bathe. Sons of men of the warrior caste stand by the side of the road, and when they see a maiden who pleases them, throw a garland over her. In the 'Simpleton's Holiday' feast, foolish people used to smear their bodies with ashes and cowdung, and for a period of seven days go about uttering all manner of coarse talk. At this time people showed no respect for kinsfolk, friends or monks when they met them, but stood in the doorways and insulted them with coarse talk. Those who could not endure this talk paid the holiday makers half or quarter of a penny to go away from their house. Even ladies of respectable family came out to see the festivities and to bathe in the river.

The 'Elephant Fish'. The Smithsonian Institution reports that six specimens of this peculiar fish have been identified by Prof. Carl L. Hubbs, of the University of Michigan, in its fish collection. It has just been described as a new genus, *Elephantichthys*, by Prof. Hubbs and his associate Dr. L. P. Schultz, on the basis of a single specimen collected at Kodiak Island, Alaska. It is now found that it was first collected about thirty years ago in Alaskan waters by Dr. Leonard Stejneger, head curator of biology, Smithsonian Institution. It was named the 'elephant fish' because of the very rough, tough skin and clumsy body, but is not identical with the African elephant fish, which has an extension of the head which looks like a trunk, nor with certain marine chimæra groups, sometimes called by the same name. *Elephantichthys* is to a certain extent compressible, and when laid on a flat surface out of water, it flattens out. Its body is very soft, but its skin nearly a quarter of an inch thick. It is a member of the cyclopterid family which cling to the rocks by a sucker on the ventral surface, the 'lump-fish' being one of its relatives.

Nerve Cells of Earthworm. F. Ogawa (*Sci. Rep. Tôhoku Imp. Univ., Biol.*, 8, No. 4; 1934) records the results of observations on the number of ganglion cells and nerve fibres in the central nervous system of the earthworm, *Pheretima communissima*. The number of ganglion cells in the cerebral ganglion (12,829) is much larger than in the subœsophageal (5,146) or any other ganglion of the ventral nerve cord, but the cells of the cerebral ganglion are smaller in size. The ratio of cells in the cerebral ganglion to the fibres in the circumœsophageal connectives is 2·3 : 1, hence the author infers the existence in the cerebral ganglion of many association cells the fibres of which do not leave the ganglion. The subœsophageal ganglion appears to be formed by the fusion of four ganglia belonging to the first, second, third and fourth segments, as it gives off four pairs of single and of double nerves. There are more ganglion cells and larger cells in this ganglion than in any other ganglion of the ventral cord. In general, the number of nerve elements in a ganglion depends on the complexity of organisation of its segment; a table shows that the number of cells varies from 931 to 4,471. The last or terminal ganglion appears to remain in an embryonic condition.

The Ascidian *Clavelina* in the Pacific. The well-known genus *Clavelina* has been regarded in its typical form as a native of the Mediterranean Sea and of the seas of north-western Europe. Now an example of the genus, described as a new species by Asajiro Oka, has been found at Shifushi, Kyushu, Japan (*Proc. Imp. Acad. Tokyo*, 10, 365, June 1934). The species, which has been named *Clavelina coerulea*, is closely related to *C. lepadiformis*, but has fewer tentacles, and the individuals are beautifully blue in colour.

Northward Extension of Mediterranean Flora. In his presidential address to the Linnean Society (*Proc. Linn. Soc.*, 3, September 1934), Prof. F. E. Weiss deals with this problem. He points out that the principal northward routes taken by Mediterranean plants have been along the Atlantic coast and up the Rhone valley. The greater number have taken the Rhone route, which is climatically better suited to their requirements. Some travelled eastwards to Switzerland along the Rhone to Geneva, some up the Saone to northern France and Belgium and some by way of the Doubs through the gap of Belfort to Alsace and the upper Rhine, which, between Basle and Mayence, is rich in Mediterranean plants and climatically well suited to them on account of the hot dry summers and maximum rainfall during the winter months. Both these latter routes were probably taken by *Buxus* and some other plants which have reached England, whilst the southern species of *Erica* have taken the Atlantic route. Evidence from distribution suggests that *Polypodium vulgare* var. *serratum* and *Ruscus aculeatus* have entered Switzerland along the Rhone valley but Chodat's contention that many species have penetrated up the southern valleys and crossed the Alps is supported in the case of *Ephedra helvetica* and other plants. The problem of the Lusitanean element in the Irish flora is reviewed, and the theory of a post-glacial immigration, probably by direct seed dispersal, is favoured.

Genetics of *Datura*. A very good account of the work of Blakeslee and his collaborators with the genetics of *Datura* has recently been published with an elaborate set of very useful illustrations (*J. Hered.*, 25, No. 3). Much of this work is already familiar to geneticists in papers published during a period of more than twenty years, but a synthetic account of the main results and the steps by which they were attained will be welcomed, for the conceptions here developed have since been widely applied to other genera. Most of the 12 chromosomes are sufficiently unlike to be recognisable, and the 12 corresponding primary trisomic mutants have all been found, as well as the two secondaries belonging to most of the primaries. For example, the primary 'buckling' has an extra 5·6 chromosome in its cells, but some of its derivatives show more extreme characters in opposite directions and the extra chromosome in them is regarded as 5·5 or 6·6 respectively due to interchange of segments. Tertiary types have also been recognised, in which the extra chromosome is composed of parts of two different chromosomes. Cultures and crosses of *Datura* from many parts of the world have shown that there are at least four types with interchanged chromosome segments, which when intercrossed produce chromosome rings. Compared with the standard line, most European races are of the *B* type, in which chromosomes 1·2 and 17·18 have interchanged giving 1·18 and 2·17. Similarly, in Peru, the races of *Datura* have the chromosomes 11·21 and 12·22, and in Jamestown, Virginia, 3·21 and 4·22, through segmental interchange. By radium treatment, which breaks the chromosomes, and subsequent self-pollination of trisomic forms, new balanced conditions have been reached with an extra pair of chromosomes. These forms breed true and are in effect new species.

Summer-Flowering Phloxes. A useful and interesting booklet on the "History, Culture and Varieties of Summer-flowering Phloxes" has been published (Bull. 588, Cornell Univ. Agr. Exp. Sta., Ithaca, N.Y., March 1934). The early-flowering species are divided into three groups—*Subulata*, *Divaricata* and *Ovatae*, whilst the late-flowering phloxes have two main groups—*Suffruticosa* and *Decussata*. The history of the cultivation of these charming plants in England and America is described, and their cultivation and propagation are discussed in detail. It is very gratifying to note that mention of diseases and insect pests can be enclosed within the compass of 130 words. The section on varieties reveals a wealth of different forms, of diverse shades of pink and white, and of all degrees of vigour.

Weather in the Northern Hemisphere. The monthly weather summaries that have been published by the *Staatlichen Forschungsstelle für langfristige Witterungsvorhersage* of Frankfurt during the past few years refer to a large part of the northern hemisphere outside the tropics, and give some information about the course of the drought that has been felt for nearly two years over large areas in Europe and North America. Among the various charts included in these reports is one which shows on a map the deviations of barometric pressure from the normal over a region that includes all the drought area. A similar map for a period of a year up to the end of last June appeared in the July report. Almost the most conspicuous feature on it was a very large area with pressure above the normal which had its centre to the north-west of the British Isles. The existence of such an area is a demonstration of the weakening of the prevailing damp south-westerly winds that in normal times are directly or indirectly the source of so much of Europe's rainfall. It is interesting to note that although many parts of England, especially eastern England, had less than their normal rainfall in August, the abnormal pressure conditions over the drought area as a whole were absent during that month, pressure being subnormal over almost the whole of North America except northern Canada, as well as over the northern part of the North Atlantic, the British Isles and Central Europe. European rainfall made for the most part a generous response in August to the increased inflow of Atlantic air, more than twice the normal having been measured at Rome, Madrid and Prague, and from one and a half to nearly twice the normal at Paris, Vienna and Berlin. The stormy first week of September in the British Isles, and particularly the activity of the Icelandic 'low', seemed almost to suggest that the abnormal régime was vanishing as quickly and mysteriously as it began, but September has a reputation for spells of quiet sunny weather and before the second week was far advanced the development of a huge European anticyclone marked the beginning of yet another chapter of the drought, the rainfall of the first half of the month being generally below the average.

Theory of Liquids. In Edser's theory of the liquid state, the expression for the surface tension involves μ, the force constant of the inverse m^{th} power law of attraction between molecules, and σ the molecular radius. Edser assumed that μ varied with temperature but later work indicates that in gases μ is independent of temperature. In two recent papers (*Indian J. Physics*, 8, 521; 1934; *Proc. Indian Acad. Sci.*, 1, 105; 1934) Dr. T. S. Wheeler has adopted the view that σ increases with temperature. σ is regarded as the radius of the spherical space

which the rotation of the molecule keeps clear of other molecules. On this view, Dr. Wheeler obtains expressions for the internal latent heat and other properties. An analysis of experimental data indicates that for certain monatomic and diatomic liquids m is 8, and for many organic liquids has the value 10. A general parachor relation of the form $\gamma \propto V^{-(m+1)/3}$ is deduced simply from Dr. Wheeler's theory. From Macleod's rule the exponent of V should be -4, which gives $m = 11$.

Artificial Radioactivity produced by Neutron Bombardment. E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segré have recently published an account of their experiments on the artificial production of radioactive elements by bombarding various elements with neutrons (*Proc. Roy. Soc.*, A, Sept.). Preliminary announcements have appeared in NATURE and in Italian papers. The neutrons can enter the nuclei of even the heaviest elements, and more than forty elements have been activated. The activity decays with halving periods varying from a few minutes to some days. In all the cases where the activity was sufficiently strong to be tested by Thibaud's inhomogeneous magnetic deflection method, the particles emitted were found to be β-particles. In many cases the artificial radio-elements could be separated out by chemical precipitations after addition of an isotopic element, and the chemical nature of the radio-elements could therefore be securely placed. The nuclear reactions studied are of the following types:

$$_{13}\mathrm{Al}^{27} + {}_0n^1 \rightarrow {}_{11}\mathrm{Na}^{24} + {}_2\mathrm{He}^4,$$
$$_{14}\mathrm{Si}^{28} + {}_0n^1 \rightarrow {}_{13}\mathrm{Al}^{28} + {}_1\mathrm{H},$$
$$_{25}\mathrm{Mn}^{55} + {}_0n^1 \rightarrow {}_{25}\mathrm{Mn}^{56}.$$

Atomic Arrangement in Alloys. W. L. Bragg and E. J. Williams have recently published a discussion of the theory of alloys which formed the subject of Prof. Bragg's Bakerian lecture (*Proc. Roy. Soc.*, A, July). The lattice of an alloy differs from that of a chemical compound in that it may be considered as a pattern of sites which may be occupied alternatively by atoms of the different constituents. If there is a regularity in the distribution of the atoms among these positions, it gives rise to a superlattice, but in general, atoms are interchanged between the sites by thermal agitation without destroying the crystalline structure. This is shown by experiments on the interdiffusion of metals and on the effects of heat treatment on the X-ray structure. The present paper regards the crystal as being in a state of dynamic equilibrium, the tendency to form orderly superlattices of lower potential energy being opposed by the random heat motion. A general analysis shows that there is a critical temperature at which a degree of order suddenly appears, an effect closely analogous to that obtained for the Curie point in magnetic theory. A particular measure of orderliness is used which probably corresponds closely to the detection of superlattice structure by X-rays and to the effect on electric resistivity. The discontinuity in properties at this critical temperature simulates a change of phase. A theory of the rate at which an alloy, not in equilibrium, relaxes towards its equilibrium condition, enables the effects of annealing and quenching to be predicted.

Thermionic Valves for Ultra-High Frequencies. Reference was made in NATURE of October 14, 1933, p. 608 to the production in an experimental laboratory of a midget type of three-electrode valve for use at radio frequencies corresponding to wave-lengths of less than one metre. The September issue of *Electronics* contains an article by B. Salzberg describing the principles of the design and construction on a manufacturing scale of such 'acorn' tubes, as they are termed—presumably from their shape and size, which is about ¾ in. overall. The elements of the tube, comprising an indirectly heated cylindrical cathode, an elliptical grid with a large number of turns, and a rectangular anode, are connected to heavy leads suitably spaced and fastened to a mica base. These leads are sealed through a small glass bowl forming the bottom of the envelope. The conventional form of pinch stem and standard base assembly has thus been abandoned in an attempt to obtain short leads and low losses suitable for working at very high frequencies. The article referred to above illustrates the construction and characteristics of one type of this valve, which has an amplification factor of 25, and an anode circuit resistance of 12,500 ohms. The interelectrode capacitances are 1·0, 0·6, and 1·4 μμF. for the grid to filament, anode to filament and grid to anode paths respectively. Such valves have been operated successfully in the usual retro-action type of oscillator circuit at wavelengths down to about 40 cm.

Origin of the Solar System. H. P. Berlage, Jr., has recently summed up his own work on the 'disc theory' of the origin of the solar system (*Ann. Bosscha-Sterrewacht* (*Lembang, Java*), **4**, 79; 1934). This worker developed an expression for the electrostatic field of the sun, due to its emission of charged particles (*Proc. Kon. Akad. Wet. Amsterdam*, **33**, 614; 1930). He supposes that the sun is continuously emitting positively charged particles, driven off by radiation pressure as suggested by Milne, and that electrons must be driven off in equal numbers by an electrostatic field, so that the sun does not acquire a secularly increasing negative charge. On the assumption that the electrostatic field is stationary, the author proves that the limiting velocities of the two kinds of particles are equal and that the space charge surrounding the sun is alternatively positive and negative. In a later paper (*Proc. Akad. Wet.*, **33**, 719; 1930) he goes on to suggest that if such a sun was surrounded by a disc of nebular matter, this matter would tend to be drawn into rings by the space charge—as soon as an atom has become ionised, it experiences a force drawing it towards a circle, the intersection of the disc with a sphere of minimum potential. The author compares this with Chladni's sand figures on a vibrating plate. The diameters of the rings then satisfy Bode's law. If the limiting velocity is v_0 and n material positively charged corpuscles are radiated by the whole sun per second, we must have, if the ring diameters are to coincide with the actual orbits of the planets, $ne^2/mv_0^3 = 80$, where m is the mass of the electron. It is suggested that the solar system actually originated in an original disc being broken up into rings by an electrostatic field, and that the rings later aggregated into planets. It is further suggested that the planetary satellite systems were formed by exactly the same process. The author adds that it remains to be proved that the planets have been the sources of emission of charged particles, and that, so far as he can see, these rays are the sole agencies by which gaseous discs surrounding planets can be compelled to condense into satellites.

Chemistry of Milk

RECENT work on the chemistry of milk was discussed at a joint session between Sections B (Chemistry) and M (Agriculture) on September 11 at the Aberdeen meeting of the British Association. For convenience the discussion was divided into two parts: (1) a consideration of milk, normal and abnormal, from the analytical point of view; and (2) a survey of recent work on some of the more important organic constituents of milk, namely, casein, milk fat and vitamins.

Prof. H. D. Kay (Reading), in a general introductory paper, pointed out that despite their inherent academic interest and their enormous importance in human nutrition, in agriculture and in industry, it is only comparatively recently that the chemistry and physiology of milk secretion have become subjects of serious study and research. Our fundamental knowledge of lactation from the chemical and biochemical point of view is still surprisingly meagre. To mention a few only of the many questions on which little effective light has as yet been thrown, we are almost entirely ignorant as to what factors control the chemical quality of milk as secreted by the cow; we do not know why the main protein of milk is a peculiar and unusual one—a phosphoprotein—or why milk fat has its very peculiar composition with its high percentage of volatile fatty acids, or why the sugar in milk is lactose and not some more common sugar, or why citric acid is present in appreciable quantities in fresh milk. Have these peculiarities arisen during long ages of evolution to meet specific needs of the young suckling, or are they the result of some secretory necessity of the mammary gland? No answer to these and other fundamental questions, many of which are both scientifically fascinating and economically important, can be attempted until a wider and more precise knowledge of the chemistry of milk is available.

In the analytical part of the discussion, Dr. J. F. Tocher (Aberdeen) considered the composition of milk in relationship to the existing regulations, designed to safeguard the consumer against having his milk spuriously diluted, and described methods used for determining, from the predicted and observed values of certain of the non-fatty solids in the milk, whether or not a sample of milk has been 'watered'. He also described critically his recent work on the determination of the freezing point of milk, the range of variation of which, over a large number of samples of fresh milk, is known to be small, but which according to his own findings is rather larger than the usually accepted range. His variations are from $-0{\cdot}50°$ to $-0{\cdot}56°$ C., and he finds that the mean value of the freezing point of the milk of individual cows is not the same from one herd to another. He advocated caution in making any statement, based on cryoscopic determinations alone, as to the exact quantitative extent to which a given sample of milk has been adulterated with water.

Dr. W. L. Davies (Shinfield) dealt with the limits between which cow's milk may vary in analytical composition and still be considered normal. In abnormal milk the percentage of specific milk constituents, particularly casein and lactose, is usually low. If it is assumed that normal milk contains 76 per cent of its total nitrogen as casein nitrogen, then abnormal milk may be regarded as normal milk plus a diluting fraction, and the nitrogen distribution, chloride content, etc., of the diluting fraction can in any given case be calculated. On making this calculation it is found that the diluting fraction is not far removed in composition from blood serum or from certain types of œdema fluid. These findings appear to put the changes known to occur in abnormal milk on to a more intelligible basis.

A short but lively discussion on these two papers was opened by Capt. John Golding (Shinfield). Capt. Golding believes that Dr. Tocher's range of variation in freezing points is much too great for fresh samples of genuine milk, and quoted a very extensive series of determinations of his own, where, with genuine milk of the most abnormal composition, the freezing point was so constant from one milk to another as to be scarcely ever outside the small experimental error of his method. Never under any conditions has he himself come across a fresh, genuine milk with a freezing point outside the range $-0{\cdot}537°$ to $-0{\cdot}570°$ for mixed milks: 99 per cent of these determinations fall between $-0{\cdot}545°$ and $-0{\cdot}555°$. Mr. A. L. Bacharach (London) emphasised that the long contest between analyst and adulterator is by no means rendered one-sided by the increasing use of the cryoscopic test, despite the remarkable constancy of the freezing point in fresh milk. By careful sophistication with 'solutions of electrolytes', the scientific adulterator can evade even the freezing point test. Sir Robert Robertson (London) mentioned the difficulties that arise if milk for a freezing point test is received after some souring has taken place. It is, however, possible, even with milk in which bacterial changes are already advanced, to compute with some accuracy, from the results of a careful analysis of the milk, what the original composition would have been, and thus give an opinion as to whether the freezing point claimed for the milk in its original fresh condition is likely to be correct.

The second half of the discussion was opened by Dr. K. Linderstrøm-Lang (Copenhagen), who described his work on the fractionation of casein into several different protein components which show marked differences in their content of phosphorus, tyrosine, tryptophane, histidine and alanine, as also in their specific rotation and base-binding capacity. It appears from this work that casein should be regarded not as a single protein of very large molecular weight but as a mixture of smaller protein units, with certain chemical similarities, and possibly very loosely linked together. It forms a co-precipitation system which is, however, fairly readily resolvable by simple physical methods.

Dr. Linderstrøm-Lang also dealt with recent work on the chemical make-up of casein, particularly the form in which phosphoric acid is combined with the rest of the protein molecule. The recent isolation by Lipmann of a new amino acid, phosphoserine, from casein hydrolysates demonstrates that some at least of the phosphorus in casein itself is present linked to serine. From other recent work of Levene and Hill, it may be concluded that a glutamic acid molecule is also a near neighbour of phosphoserine in the casein molecule. Investigations of the rate of splitting off of phosphorus as phosphoric acid suggest that all the phosphorus in casein is bound in a similar way, which is almost certainly an ester linkage to hydroxyamino acids, but all the phosphorus is not necessarily bound to the *same* hydroxyamino acid.

The peculiar constitution of milk fat is emphasised by the recent work which was reported by Prof. T. P. Hilditch (Liverpool). It has been known for some time that there is a large proportion of fatty acids of relatively low molecular weight, from butyric acid upward, in milk fat. Whilst on the whole there is a remarkable constancy in the proportions of the various fatty acids in milk fat from cows in countries so far apart as England, New Zealand and India, there are minor variations depending in part on the diet. Stall-fed cows produce a more saturated butter fat than cows at pasture, and the unsaturation is increased shortly after the cows go out to grass in spring. As the unsaturation increases, the quantity of low-molecular fatty acids diminishes. Increasing age of the cow appears to increase the proportion of oleic acid slightly at the expense of palmitic acid. A diet in which fat containing fatty acids of a particular or unusual type is present influences the composition of the butter fat by slightly increasing the content in the butter of such characteristic fatty acids, and correspondingly diminishing the content of certain of the fatty acids present in normal butter. The influence of cod liver oil is particularly marked in diminishing the amount of volatile fatty acids in the butter.

The comparative heterogeneity of the triglycerides present in butter contributes very considerably to the important economic quality of 'spreadability' and to the relatively low melting point of butter fat.

Dr. S. K. Kon (Shinfield) contributed the last paper. He described work extending over three complete years on the changes in vitamin content of milk throughout the year. Winter butter from cows on the usual winter rations has been clearly shown to have a smaller vitamin content than summer butter from the same cows. Direct photometric measurement of the vitamin A *sensu stricto*, and of the carotene content of butters in relation to their total vitamin A activity as estimated biologically, has yielded the interesting finding that the biological growth-promoting power of true vitamin A of butter is 5–7 times that of an equal weight of butter carotene. Experiments were described which showed that the antirachitic effect of butter is due only in part to the classical vitamin D. There is another factor in butter which, unlike irradiated ergosterol, is easily inactivated during saponification, but which is effective in the prevention or cure of experimental rickets in rats. The reversible oxidation of vitamin C in milk in the presence of light was described. Ordinary daylight even through glass bottles is effective in accelerating this oxidation, which appears to be less and less reversible as the time of exposure of the milk to the light increases.

The Frontiers of Science

SCIENCE, as an advance of organised knowledge into Nature, is constantly driving its frontiers into the region of the unknown and the unexplained. The record of that conquest is as dramatic and important as any that historians have to analyse and describe. But the frontiers of science are not merely abstract ones in the realm of thought; historically they have also moved geographically into new worlds, and new influences have penetrated into systems of organised knowledge by geographical routes which are still traceable. Within the system of science also, the lines between various departments have been constantly moving and classifications of knowledge transmuted. Historians of science are largely occupied with this problem of the external and internal boundaries of science, and their attempts to map out the development is of great importance as a contribution towards science's understanding of itself.

The increasing self-consciousness of science, shown by the philosophic preoccupations of physicists and biologists and the development of a social conscience by the British Association, stimulates its historical memory. After congresses in Paris in 1928 and in London in 1931, a third international congress under the auspices of the International Academy of the History of Science was held this year in Portugal on September 30–October 6, under the presidency of Dr. Fernando de Vasconcelos. Besides a distinguished group of Portuguese scholars, representatives from, among others, Belgium, Czechoslovakia, Egypt, France, Great Britain, Italy, Morocco, Norway, Roumania, Spain and the United States were present. The absence of German representatives was conspicuous.

The obligations of science and in particular of historians of science were emphasised by Dr. George Sarton of Harvard in an inaugural address. He directed attention to the dangers that threaten the independence of science in many countries to-day, and protested against the prostitution of the history of science to serve the narrow ends of national or political propaganda. He believes that in the true history of science there is a firm basis for international understanding and a potent method of humanising the sciences and more intimately relating the interests of humanists and workers in natural science.

These general questions were considered further in a discussion on the unity of science in which Dr. Henriques of Rome urged that it is one of the important tasks of the history of science to emphasise the relative and temporary nature of the subdivisions of the sciences, often artificially perpetuated by administrative and teaching habits, and to insist always that the necessarily specialised studies of experts should be approached from, or at least related to, the concept of the unity of science. Although the idea of unity raises problems of definition of a metaphysical character, the practical bearing of the suggestion for the teaching of the history of science was recognised by the decision to appoint a committee of the Academy under the chairmanship of Dr. A. Reymond of Lausanne to investigate and report on a programme of international collaboration in the teaching of the history of science.

The international character of science, and the fictitiousness of the boundaries between the various branches of sciences, were shown by the papers presented at the sectional meetings. The general theme was the geographical expansion of scientific knowledge, the function of the various sciences in shaping the movement of European expansion in the age of the discoveries, and the diffusion of knowledge within Western culture. A series of papers by Portuguese representatives showed that the fundamental work of Joachim Bensaude on early Portuguese astronomy has been followed by similar studies in other fields. Perhaps the most important of these papers were

those by Dr. Fontoura da Costa on "Portuguese Maritime Science in the Age of Discoveries", summarising the contributions made by the Portuguese to cartography, navigation technique and other nautical sciences; by Dr. Ricardo Jorge on "The Place of Medicine and Doctors in Portuguese Expansion", particularly interesting for its discussion of the exchange between East and West of drugs and diseases; and by Dr. Arlindo Monteiro on "Portuguese Influence on Japan". They showed how fundamental scientific and technical advances are to overseas discovery and what complex repercussions the discoveries had on European learning.

Among the other papers illustrating this general theme of the movements of learning were those by Dr. Fernando Correia on "Portugal in the History of Public Health", and more specialised studies by Dr. Max Meyerhof, M. Tricot-Royer, Dr. H. Renaut, M. Quido Vetter and Dr. Joachim de Carvalho. It is intended to publish these and other papers presented to the Congress shortly.

The social success of the Congress was due to the well-conceived plans of the secretary, Dr. Alberto Pessoa, and the genius which the Portuguese possess for cordial hospitality. The opening session was held at Oporto, which gave the members of the Congress an opportunity to see the Colonial Exhibition and the impressive historical procession through the city illustrating Portuguese expansion which marked the end of the exhibition. After a reception by the municipality in Oporto and excursions to Gaia and the wine vaults, the Congress travelled to Coimbra and held its main sessions in the beautiful buildings of that old University, in the library of which a special exhibition of medical books of the sixteenth and seventeenth centuries had been arranged. Official receptions were given by the Rector of the University and by the municipality. The members of the Congress then travelled by motor coach to Lisbon, visiting the monasteries of Batalha and Alcobaça, and being officially received by the municipality of Caldas da Rainha. The closing session at Lisbon was followed by a reception by the municipality. In this way, members of the Congress were enabled to see very fully the richness of the historical remains in Portugal and to appreciate the greatness of its colonial past and present.

The International Academy decided to hold its next Congress in Prague in 1937, under the presidency of M. Quido Vetter.

Bearing Metals

It is now nearly a century since Isaac Babbitt introduced a bearing comprising a liner of a relatively strong and rigid material coated with a thin layer of white metal. The advantages of this combination have proved of great importance in engineering practice, but more attention has been directed to the metallurgy of the white metal coating than to the mechanics of the bearing as a whole.

The advent of the high-speed aeroplane has brought in its train certain difficulties, particularly a type of cracking of the white metal which has been generally ascribed to 'fatigue', though the evidence for this has not been conclusive. The Institute of Metals at its meeting in Manchester on September 4 devoted considerable attention to this question. D. J. Macnaughtan, director of the International Tin Research and Development Council, presented a general discussion of this type of cracking and for the first time provided a rational explanation of the stress conditions under which the fatigue is set up. In essence, the explanation depends upon the simultaneous action in the white metal of a varying compressional stress and a tension which appears to be mainly due to the different coefficient of contraction of the bearing metal and the liner into which it is cast.

From this work the conclusion may be drawn that the fatigue range of the antifriction metal is the mechanical property of prime importance, though the coefficient of expansion of the liner, by determining the value of the tension, plays an important part. The author showed that in a series of copper, antimony, tin alloys with 3·5 per cent of copper, the fatigue range increases as the antimony content is raised up to about 10 per cent. It is generally recognised that in similar materials the tensile strength and the fatigue range follow more or less parallel curves, whilst in addition the Brinell hardness number would be expected to follow a similar course. The confirmation that in the white bearing metals these three properties are interconnected results in the tensile strength and the Brinell hardness, which are relatively easily determined, representing reasonable qualitative measures of the fatigue limit.

This paper was followed by an account of three researches on the general behaviour of white bearing metals when subjected to various deformation tests. Part 1, by A. S. Kenneford and Dr. H. O'Neill, dealt with the measurement of hardness and, quite apart from the specific application of this work to the bearing metals themselves, forms a very valuable contribution to the general question of the measurement of hardness of soft metals. If one particular section of this research may be picked out for special reference, it is the use of cones of the alloy, chill cast with an angle of 60°, which are compressed under known loads. The degree of compression gives a measure of the hardness of the material, whilst the cracking, or absence of it, of the lip extruded at the top, provides qualitative information regarding its ductility.

The tensile strength at ordinary temperatures of a number of typical white metal bearing alloys cast at different temperatures and into moulds at different temperatures, are recorded in a paper by R. Arrowsmith. The strongest alloy was found to be one containing about 10 per cent of antimony and 4 per cent of copper hardened by the addition of 1 per cent of cadmium. The best casting conditions were a pouring temperature of 450° C. into a mould at about 200° C.

The third and last section of the work dealt with pounding tests by H. Greenwood. Despite the obvious practical importance of a test of this character, very little work has previously been done and even this is by no means free from criticism. Greenwood has shown that the rate of deformation—after a preliminary period due to the bedding-in of the indenting tool into the bearing—is constant, and may be employed to give a strictly quantitative measure of the resistance of the alloy to pounding stresses. The alloy which gave the highest tensile strength was also found to be most resistant to this type of deformation. These tests have been carried

out at temperatures up to 160° C. using 100,000 blows from a modified Stanton impact testing machine as standard.

The results published in these papers represent a preliminary survey of the mechanical properties of white bearing metals which is essential if the effect on the standard alloys of other additions is to be measured. The work, which has been carried out in the Metallurgical Department of the University of Manchester, has been rendered possible by financial assistance from the International Tin Research and Development Council, and is, even in its present stage, one of the most comprehensive examinations of these alloys which has yet been undertaken. F. C. T.

The Origins of Plankton

In the course of a discussion on the "Biological Problems of Fresh Water" before a joint meeting of Sections D and K of the British Association at Aberdeen (NATURE, Sept. 22, p. 467), Prof. F. E. Fritsch pointed out that one of the outstanding problems confronting workers in this field is that of discovering the origins of the many recurrent cycles of free-floating organisms (plants and animals) that occur in the surface layers of standing waters and at times populate them in such enormous numbers that they lend a definite colour to the water.

Such populations, constituting the plankton, often last only for a few weeks and then vanish completely, only to reappear each year usually at approximately the same time. They are often a source of considerable trouble in reservoirs. On the other hand, the plankton is also of great economic importance in that, directly or indirectly, it constitutes an important part of the food-supply of fish.

A small number of the manifold plants (algæ) of the plankton, at the end of their period of abundance, form special resting-stages (spores) which gradually sink to the bottom or into the deeper waters, but there is no evidence that this is of general occurrence. Most species must persist from one season to the next in the form of occasional unaltered individuals. The problem at issue is whether such persisting individuals and spores remain viable wherever they are deposited, or whether it is only those that settle in the shallower waters round the banks that retain their vitality and give rise to a fresh crop in the next season. It is known that some of the diatoms of the plankton are bred in the shore waters and from there gradually spread into the general body, but for the vast majority of plankton algæ there is no evidence that this happens, and it is likely that many are derived from spores or persisting individuals which have lain dormant at the bottom under the deeper waters during their period of absence from the surface layers. This is particularly likely to be true of the numerous blue-green algæ of the plankton. These forms owe their buoyancy to the development of minute cavities, containing gases, in the protoplasm of their cells. Continental workers have found some evidence that these so-called gas-vacuoles are a result of the fermentation processes which are believed to take place in the cells in the absence of oxygen, when such forms—either as individuals or spores—are resting at the bottom. The production of gas renders them buoyant so that they float to the surface and appear in the plankton, while new spores which lack the gas-vacuoles are heavier than water and again sink to the bottom.

It is thus probable that the plants of the plankton are recruited from two sources, in part from resting-stages or persisting individuals lying on the bottom under the deeper waters, and in part from similar stages that survive near the banks. The degree of importance of the latter element will depend on the extent of the shallow water near the banks and the facilities for the distribution of the forms growing there into the open water.

Much detailed research is still requisite before precise knowledge on these matters is available, research which is of fundamental importance in all aquatic biological investigations. G. A. S.

University and Educational Intelligence

CAMBRIDGE.—J. S. Turner of Selwyn College has been appointed University demonstrator in botany.

L. J. Audus of Downing College has been appointed to the Frank Smart University studentship in botany.

At Queens' College the following have been elected into reserved fellowships :—F. Goldby of Gonville and Caius College, University demonstrator in anatomy; J. A. Ramsay of Gonville and Caius College. At Downing College, E. B. Verney, Shield reader in pharmacology, has been elected into a professorial fellowship.

LEEDS.—Dr. L. H. Stickland has been appointed biochemist in the Cancer Research Laboratories, in succession to Dr. Havard, who has resigned.

LONDON.—The Surrey County Council has decided to make a grant of £50,000, payable over ten years and subject to the approval by the County Council each year of the inclusion of the amount in the annual estimates, towards the erection of the University buildings in Bloomsbury. A grant towards the same purpose of £10,000, payable over ten years, has also been made by the Hertfordshire County Council. The Worshipful Company of Turners has made a donation towards the Ceremonial Hall.

FOREIGN students in the United States in 1931 numbered more than eight thousand according to a report recently published by the Federal Office of Education, as Pamphlet No. 48 on "Residence and Migration of College Students". A similar report published in 1926 as Bulletin No. 11 gave the number of foreign students in 1923 as 6,692. Although the two sets of statistics are not strictly comparable, it seems clear that there has been a substantial increase in the number of students resorting to the United States from other countries for post-secondary education and for research. Analysing the figures according to the students' home-residence, one finds noticeable increases under Canada (from 1,251 to 1,896), Mexico (298 to 402), Central America (118 to 187), Colombia (40 to 67), Scotland (26 to 55), Ireland (32 to 59), Belgium (30 to 51) and Italy (35 to 82), but decreases under China (1,605 to 1,317), Japan (583 to 502), India (288 to 235), Russia (190 to 153), South Africa (130 to 73), Argentina (51 to 29), Chile (60 to 36) and Peru (54 to 25).

Science News a Century Ago

Meteorology in America

On October 29, 1834, a joint committee of the American Philosophical Society and the Franklin Institute issued a circular with the object of obtaining a complete knowledge of all the phenomena accompanying one or more storms of rain or hail, not only where the violence of the storm was felt but also at and beyond its borders. Various hints were given to observers on the observation of the wind and clouds. They were asked particularly to "inquire the course of the wind at the commencement of the storm, and at its termination; the width of the storm; its direction; its velocity; the direction of the wind at its sides; how the wind veers round—whether in different directions at its sides, or not; whether in case of hail, there are two veins, or only one; where there is the greatest fall of rain . . . and whether this fall takes place near the beginning, middle, or end of the storm; whether the clouds are seen moving with the wind or against it; and whether differently among themselves; and everything else which you think may tend to an explanation of this most interesting phenomena." The circular gave instructions for the construction and use of simple apparatus for taking the dew-point, but it said nothing about observing the movements of the barometer.

Road Travel a Century Ago

On Friday, October 31, 1834, the *Times* published a long account of a dinner given two days earlier in Glasgow to the Earl of Durham. At the same time it gave some information as to the methods by which news had been obtained so quickly. "Our express," it said, "left Glasgow at 12 o'clock on Wednesday night and reached us at half past 7 o'clock this morning. . . . On completing a second journey of considerable length and extraordinary speed we should be guilty of great injustice if we did not offer our warmest acknowledgements to the innkeepers throughout the whole line for the zeal and ability with which they accomplished their essential part of the task. . . . The mode by which a more expeditious communication between London and Edinburgh may be obtained is obvious. All local feelings and prejudice should be laid aside. An accurate survey of the whole extent of the road should be procured, similar to that which was made some years ago of the country between London and Holyhead. . . . It will be found that in Scotland the distance may be reduced not less than 30 miles, and a new road from Doncaster to Selby affords a further reduction of five miles. The mail may thus perform the journey from Edinburgh to London in three hours and a half less than the present time, without increasing the speed to a degree which would be dangerous to the passengers and ruinous to the contractors".

Public Education in Great Britain

A Select Committee of the House of Commons was appointed in June 1834 to inquire into the state of education in England and Wales, but by the end of the session, it had only examined 21 witnesses and thus was not in a position to issue a report. Certain evidence was, however, printed, and on November 1 the *Times* published some of that given by the Lord Chancellor. To the question, "Do you think that a system of primary education established by law would be beneficial?" he had replied, "I think that it is wholly inapplicable to the present condition of the country, and the actual state of education. Those who recommend it on account of its successful adoption on the Continent, do not reflect upon the funds which it would require". It was probable, he said, that the present schools supported mainly by voluntary contributions were capable of educating nearly 1,400,000 children. For the Government to establish schools throughout the country for 2,000,000 children, no fewer than 40,000 schools would be required "which allowing only 50£ a year for all expenses of salary and rent would cost 2,000,000£ a year". The Lord Chancellor also considered that compulsory education was not justifiable on principles of public utility or expediency.

Societies and Academies

PARIS

Academy of Sciences, September 17 (*C.R.*, 199, 593–608). CHARLES CAMICHEL, EUGÈNE FISCHER and LÉOPOLD ESCANDE: The use of different vertical and horizontal scales in studies on reduced models in hydraulics. The practice is common in laboratory experiments in hydraulics. There is no geometrical similitude between the work and the model: the latter is a conventional representation of the work to be studied and there is no theoretical reason for assuming that the hydraulic movements existing in the model will be the representation, on the same conventional bases, of phenomena capable of being reproduced in the work. Experiments bearing on this problem are described and it is found that in some respects, such as the surfaces examined in the actual study, there is no concordance between the various models. PAUL DELENS: Isothermal families of developable surfaces. A. J. MACINTYRE: A theorem on ultraconvergence. R. DE MALLEMANN and P. GABIANO: The magnetic rotatory power of hydrogen arsenide and of hydrogen phosphide. Hydrogen arsenide gave a Verdet constant of $A_0^{760} = 68 \times 10^{-6}$ (minute): hydrogen phosphide, $A_0^{760} = 57 \times 10^{-6}$ (minute). J. WOHLGEMUTH: Study of the binary systems water — sodium hydrazoate, water — potassium hydrazoate. T. TARADOIRE: The action of sulphur on chlorates. Mixtures of barium chlorate and sulphur, or of lead chlorate and sulphur are stable when dry and can be kept for a long time in closed vessels without alteration. On adding water, these mixtures after a time inflame spontaneously at the ordinary temperature. The presence of combustible material is not a necessary condition for inflammation. LOUIS FAUCOUNAU: The action of ethylene oxide on acetylene magnesium compounds: the preparation of substituted acetylenic alcohols of the type $R.C \equiv C.CH_2.CH_2OH$. The preparation and properties of the alcohols containing amyl, hexyl and phenyl are described. ALFRED CARPENTIER: Contribution to the study of the male fructifications of the Neuropterideæ.

September 24 (*C.R.*, 199, 609–620). D. POMPEIU: The definition of analytical functions of two variables. MLLE. SUZANNE VEIL: Qualitative chemical observations in flat sheets of gelatine. The two drop method on a gelatine plate, previously studied from the point of view of the periodicities of precipitation, can be used as a general method of qualitative analysis. Some examples are given. HENRI GAULT and ALBERT ROESCH: Dimethylolmalonic acid and

ester. ROBERT LAMI: Specific alkalinisation and the distribution of Algæ in coast pools. A. JHILLET and R. ZITTI: *Molinia cœrulea*, a toxic grass, containing hydrocyanic acid. MLLE. EDNA HARDE: Ascorbic acid (vitamin C) and toxic effects. From the observations described it would appear that ascorbic acid exerts a protective function against a certain number of infections and toxic effects, especially those giving rise to lesions of the suprarenal cortex and the gastro-intestinal tract.

CRACOW

Polish Academy of Science and Letters, July 2. E. ZYLINSKI: Some linear spaces. M. WOJCIECHOWSKI: Thermochemical researches on the diazo derivatives of *p*-chloraniline and of some other amines. K. DZIEWONSKI, ST. KUZDRZAL and J. MAYER: Studies on 2,7-diacetofluorene. K. SMOLENSKI and S. KOWALEWSKI: A combustible liquid obtained starting with ethylene. With an initial pressure of 34–90 atmospheres, polymerisation commences at 300°–350° C. and is completed at 400° C. The whole of the ethylene can be converted into liquid products. H. LICHE: The photic reactions of *Limnaea stagnalis*. Proof that the gasteropods can distinguish colours. J. ZACWILICHOWSKI: Researches on the innervation of the sensorial organs of the wing of *Oxypterum* (*Diptera puppipara*). L. W. WISNIEWSKI: *Prohemistomulum opacum*, larval form of the Cyathocotylidæ (Trematoda). S. KÉLER: The Mallophaga of Poland. ST. SMRECZYNSKI: Contributions to the knowledge of the embryonic development of the curculionid, *Phyllobius glaucus*. L. J. BLACHER, L. D. LIOSNER and MME. A. WORONZOWA: The mechanism of the perforation of the opercular membrane in the tail-less batrachians.

GENEVA

Society of Physics and Natural History, July 5. CH. WAKKER: The application of some photoelectric cells to the determination of nitrous gases and ozone. The author describes a continuous and rapid method of determination of the oxides of nitrogen and of ozone utilising selenium or gas photoelectric cells: he shows that the former are more easy to use and are generally more certain. J. WEIGLE and H. SAINI: The transformation of ammonium bromide at − 40° C. The study of ammonium bromide (cubic lattice) has been carried out below its transformation point (about − 40° C.) first by the Laue method and then with a Böhlin precision chamber. These researches have shown that this salt ceases to be cubic below − 40° C., confirming the observations of Hettich, who found that at a low temperature it becomes doubly refracting. J. WEIGLE and R. LUTHI: Some negative results on the dielectric constant. Acting with ultra-sound waves on liquids, distilled water, acetone, nitrobenzene, amyl alcohol, butyl alcohol, it was attempted to destroy the relative arrangement of the molecules. Measurements of the dielectric constant showed no variation. Further measurements with liquids in eddying flow also gave no result. Now it is known that in the latter case the molecular arrangement is disturbed and consequently a change in the dielectric constant might be expected. The fact that it is invariable gives an important indication. J. WEIGLE and F. HUBER: The transformation of ammonium chloride at − 30° C. The authors have studied the transformation of ammonium chloride by means of the X-rays. The lattice expands but retains its shape. The transformation extends over an interval of about 5° C. These microscopic measurements differ considerably from macroscopic observations. P. BERNAYS and P. HERTZ: The axioms of Archimedes and of Cantor. We call the following proposition the topological Cantorian axiom: given a nest of segments, that is, a collection of segments each of which with the exception of the first is contained entirely inside the preceding, there is a point in the interior of all the segments. The question arises if the axiom of Archimedes is independent of the above. The reply to this question is in the affirmative and an example is given. G. TIERCY and A. GROSREY: The width of spectrograms of stars of the type $F0$. G. TIERCY and A. GROSREY: The width of spectrograms for stars of the type $G5$. The authors discuss the variation of the width of a spectrogram as a function of the magnitude of the star and of the time of exposure, as has been done earlier for other types of spectra. P. ROSSIER: The generalisation of the Russel formula for the calculation of the colour index of a star. A formula given by the author which takes account of the fact that receivers of radiant energy have an extensive range of sensibility, contains Russel's formula as a particular case, on condition that the sharpness of the sensibility maxima is infinite. P. ROSSIER: Relation between the effective wave-length and the absolute colour index of a star. These two magnitudes are generally expressed as functions of the temperature. Eliminating this, a relation is obtained in which only the magnitudes deduced directly from experiment appear. CH. E. GUYE: The ascending propagation of imbibition. W. H. SCHOPFER: (1) The nature of the growth factor of micro-organisms. The author discusses recent work of Wassink (Utrecht) which entirely confirms observations made during the last four years, namely, the necessity of a thermostable growth factor for the growth in a synthetic medium of *Phycomyces*. (2) The preparation by dialysis of the growth factor of micro-organisms. Its existence in the anthers of various flowers. The author has perfected a new technique for the extraction by dialysis of the growth factor of micro-organisms at the temperature of − 2° C. After some hours, a dialysate is obtained containing very little dry extract but a large quantity of growth factor. Tests have been carried out with pure wheat germs, normal or irradiated, stamens, pollen, as well as with the styles of various flowers. The dialysates of the wheat germs are more active than the usual preparations. The existence of the growth factor in pollen grains, already suggested as the result of practical trials with pollen from orchids, is fully confirmed. F. BATTELLI, DON ZIMMET and A. HERSCHBERG: The effects of the application of the skin secretion of the green frog (*Rana esculenta*) to open wounds: 'ranacicatrine'. L. W. COLLET and ED. PAREJAS: Contribution to the study of the Tertiary of the Saleve (1). The region of Mornex. The authors show that the upper part of the Mornex conglomerates, which have been considered by Joukowsky and Favre as representing a continental facies (siderolithic), are marine beds, as proved by fossils. They determine the Oligocene transgression. R. WAVRE: On the representation of certain multiform harmonic functions.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 8). L. KANTOROVITCH: Conformal representation of multiconnected areas. A. SVETLOV: On the asymptotic expression of Bessel's functions with high indices. V. FESENKOV:

Determinations of the equivalent thickness of atmospheric ozone made at the Astrophysical Laboratory of Kutchino. P. TCHERENKOV: Visible luminosity of pure fluids under the influence of γ-radiation. S. I. VAVILOV: Possible causes of the blue γ-luminosity of fluids. M. P. BRONSTEIN: Some properties of radiation of very high "energy density". R. JAANUS and J. SCHUR: A new method of determining the magnetic susceptibility of gases and vapours. P. P. LAZAREV and Z. V. BULANOVA: Changes in the rate of reconstitution of the visual purple during pregnancy. P. P. LAZAREV, N. PILMANN and A. GAMBURCEVA: Influence of carbon monoxide on the adaptation of the eye. G. SMYSHLIAJAEV: Some special cases of the heating effect of the electric current in electrolytes and gases. G. CHELINTSEV: Mechanism of ester condensations. A. POLESITSKII: Distribution of radioactive elements between a liquid phase and a solid crystalline phase. The distribution of radium between the solution and the crystals of $BaCl_2.2H_2O$ in the presence of hydrochloric acid. M. IGNATJEV: Mathematical treatment of data on twins. G. CHRUSCOV: The cultures of blood leucocytes as a method of investigating the somatic karyotype of man. W. KROKOS: Contribution to the nomenclature of the quaternary deposits in Ukraine. A. TARANEC and A. ANDRIASHEV: A new genus and species, *Petroschmidtia albonotata* (Zoarcidæ, Pisces), from the Okhotsk Sea. D. TALIEV and A. BAZIKALOVA: Preliminary results of a comparison of the Baikal and the Caspian faunas by the method of precipitin reaction.

Academy of Sciences (*C.R.*, 2, No. 9). V. D. KUPRADZE: The solution of the limiting value of Helmholtz problems in exceptional cases. N. KOSHLIAKOV: Some identities in quadratic fields. L. KANTOROVITCH: A method of approximate solution of differential equations. J. MINDLIN: The generalisation of a development by Schlömilch. M. ELIASHEVICH: The high rotational levels of the water molecule. B. M. WUL and I. M. GOLDMANN: Penetrating a compressed gas in a non-homogeneous electric field. V. FREDERIKS and V. TSVETKOV: Orientation of molecules in a thin layer of anisotropic liquid and the measurement of two constants indicating their elasticity. G. LAEMMLEIN: Experimental production of vicinal phases on a growing crystal. P. DANKOV: Investigation of the surface of iron by the electronogram method. N. PREOBRAZHENSKIJ, A. POLIAKOVA and V. PREOBRAZHENSKIJ: Synthesis of homopilopic acids. V. SADIKOV, V. MENSHIKOVA, R. KRISTALLINSKAJA, E. LINDQUIST-RYSAKOVA, E. HALECKAJA, A. PESINA and L. RUBEL: Catalytic splitting of the serumalbumin by 3 per cent sulphuric acid. D. MICHLIN and Z. ZAPRUDSKAJA: Synthesis of fat in the milk gland. N. KRASILNIKOV: The developmental history of the soil microbacteria. N. CHLEBNIKOVA and G. BOLONOZ: Biochemical control of heat resistance. N. N. JAKOVLEV: A specimen of the genus *Gymnosolen* from the lower Cambrian in Eastern Siberia. P. SCHMIDT and A. TARANEC: The new southern elements in the ichthyofauna of the northern part of the Sea of Japan. N. KOZHANTCHIKOV: The rôle of the energy metabolism in the pupal development of *Agrotis segetum*, Schiff. and of *Ephestia kühniella*, Zell.

MELBOURNE

Royal Society of Victoria, July 12. ROBERT B. WITHERS and R. A. KEBLE: The palæozoic brittle-stars of Victoria. This paper completes the work of the authors on the palæozoic Stelleroidea of Victoria. The list of brittle-stars in Victoria has been increased from 4 to 13 species. Seven of these are new to science and two new to Victoria. With one exception, this includes all the palæozoic brittle-stars recorded in Australia. The 13 species are comprised in 10 genera. R. T. PATTON: Ecological studies in Victoria (3). Coastal sand dunes. The flora is closely allied to characteristic Australian genera, although specifically there is no close connexion. The leaves are comparatively large and range from succulent, with 1,300 per cent of water, to sclerophyllous, with 118 per cent. Although the leaves are xeromorphic, the plants cannot be regarded as xerophytic, since generally there is no deficiency of moisture in the sand. The rainfall is fairly evenly distributed over the year and this sinks to lower levels in the sand. Experiments with dune-sand show that the amount of moisture in the upper layers is affected by time, depth of moist sand, and holding capacity of the sand itself. The sand-grains are mainly 1/40–1/80 in. in diameter. The vegetation consists of three phases, grass phase (*Spinifex hirsutus*), shrub phase (*Acacia Sophoræ, Olearia axillaris*), and tree phase (*Banksia integrifolia, Leptospermum lævigatum*). From front to rear the dunes exhibit a series of successions, in species, life forms, soil cover, and soil acidity. E. S. HILLS: Some fundamental concepts in the physiography of Victoria. Evidence is adduced for the existence of relics of a Cretaceous land surface, which upon uplift and dissection gave rise to the Oligocene (?) surface upon which the Older Basalts were extravasated. The divide in Older Basaltic times was close to its present position. Post-Kalimnan earth movements have determined the major topographic features of the State, with a maximum uplift in the Middle or Upper Pliocene. The existence of Tertiary faulting in the Eastern Highlands is questioned and stress is laid on the differential erosion as the chief factor determining the topography. F. CHAPMAN, W. HOWCHIN and W. J. PARR: A revision of the nomenclature of the Permian Foraminifera of New South Wales. This revision of the nomenclature published in 1905 is necessitated by the great advances made in the group during the last twenty years. Critical notes are given on the genera *Monogenerina*, *Spandelina* (including *Spandelinoides*) and *Geinitzina*. *Geinitzina* has a finely perforate shelf-wall, and also, along with *Frondicularia woodwardi*, the rare character amongst palæozoic foraminifera, a stellate aperture. In the microspheric form there is a gently curved series of three or four chambers following the proloculum. This lends support to Hofker's theory that the openly coiled Marginuline type of the Nodosarians is geologically older than the closely coiled Cristellarians (*Lenticulina*). FREDERICK CHAPMAN: New species of a crinoid (*Lecanocrinus*) and a cephalopod (*Ophidioceras*) from the Silurian of Yass. *Lecanocrinus breviarticulatus*, sp. nov. is represented by a more or less perfect crown attached to a well-preserved mould of the stem. It is compared in general features with *L. billingsi* Angelin, from the Silurian of the Island of Gotland. This species was discovered by Mr. A. J. Shearsby and is apparently the first occurrence of the genus in Australia. *Ophidioceras giblini*, sp. nov. has distinctive features which separate it from known species in the Silurian of England and Bohemia. This fine specimen represents the first occurrence of the genus in Australia.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, October 28

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30. Dr. A. T. Hopwood: "Geological Galleries".*

Tuesday, October 30

ROYAL INSTITUTION, at 5.15.—Olaf Bloch: "Progress and Problems in Photography".

THE EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, London, W.1). Prof. H. Muckermann: "The Eugenic Movement in Germany".*

BEDFORD COLLEGE, LONDON, at 5.15.—Dr. Edwin Deller: "Some Principles of University Administration" (Stevenson Lecture).

Thursday, November 1

ROYAL SOCIETY, at 4.30.—Discussion on "The John Murray Expedition". Opening address by Lieut.-Col. R. B. Seymour Sewell.

LONDON (R.F.H.) SCHOOL OF MEDICINE FOR WOMEN, at 5.30. Prof. G. Barger: "Some Chemical Problems related to Pharmacology" (succeeding lectures on November 2 and 9).*

Friday, November 2

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—C. Day: Presidential Address.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Sir Arthur W. Johns: "Recent Progress in Naval Architecture" (Third Andrew Laing Lecture).

ROYAL INSTITUTION, at 9.—Dr. F. W. Aston: "Elements and Isotopes".

Official Publications Received

GREAT BRITAIN AND IRELAND

The Royal Technical College, Glasgow. Calendar for the One Hundred and Thirty-ninth Session, 1934–1935. Pp. 460+xxiv. (Glasgow.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1590 (T. 3410, Part 2): An Experimental Investigation of the Wake behind an Elliptic Cylinder. By Dr. G. J. Richards. Pp. 6+6 plates. 9*d*. net. No. 1591 (S. 174): Full Scale Water Resistance in Steady and Accelerated Motion. By E. T. Jones. Pp. 30+16 plates. 1*s*. 9*d*. net. No. 1594 (S. and C. 590): Landing and Take-off Speeds of Aeroplanes. By R. S. Capon. Pp. 7+2 plates. 6*d*. net. (London: H.M. Stationery Office.)

Empire Cotton Growing Corporation. Second Conference on Cotton Growing Problems, July 1934: Report and Summary of Proceedings. Pp. 340. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*.

Directory for the British Glass Industry. Compiled by G. S. Duncan. Third edition. Pp. 412. (Sheffield: Society of Glass Technology.) 4*s*.; to Members of the Society, 3*s*. 6*d*.

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1934–35. Pp. 396. (Manchester.)

Reports of the Imperial Economic Committee. Twenty-eighth Report: Maize. Pp. 60. (London: H.M. Stationery Office.) 1s. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1522 (T. 3298): Interference between Bodies and Airscrews, Part 2. By C. N. H. Lock and H. Bateman. Pp. 27+3 plates. 1*s*. 6*d*. net. No. 1584 (T. 3329 and "B"): Effect of a Contraction on the Turbulence in a Fluid Stream. By A. Fage. Pp. 8+2 plates. 6*d*. net. No. 1587 (S. and C. 540 and "b", 567): Wind Tunnel Tests on (1) Frise Aileron with Raised Nose, (2) Hartshorn Ailerons with Twisted Nose. By A. S. Hartshorn and F. B. Bradfield. Pp. 13+8 plates. 9*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Royal Irish Academy. Vol. 42, Section C, No. 7: Studies in the Significance of the Irish Stone Age; The Campignian Question. By C. Blake Whelan. Pp. 121–143. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Ministry of Agriculture and Fisheries: Fisheries—England and Wales. Salmon and Freshwater Fisheries: Report for the Year 1933. Pp. 44+6 plates. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Recommendations of the British X-Ray and Radium Protection Committee. Fourth revised Report (June 1934). Pp. 10. (London: Prof. S. Russ, Middlesex Hospital.)

Aeronautical Research Committee. Report for the Year 1933–34. Pp. iv+89+4 plates. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

OTHER COUNTRIES

Memoirs of the American Academy of Arts and Sciences. Vol. 17, No. 2: The Wood-Feeding Roach Cryptocercus, its Protozoa and the Symbiosis between Protozoa and Roach. By L. R. Cleveland, in collaboration with S. R. Hall, Elizabeth P. Sanders and Jane Collier. Pp. x+185–342+60 plates. (Boston, Mass.)

Bulletin of the Bingham Oceanographic Collection. Vol. 4, Art. 6: Report on Experimental Use of a Triangular Trawl for Bathypelagic Collecting, with an Account of the Fishes obtained and a Revision of the Family Cetomimidæ. By Albert Eide Parr. Pp. 59. Vol. 4, Art. 7: Littoral Penæidea chiefly from the Bingham Oceanographic Collection, with a Review of *Penæopsis* and Descriptions of Two New Genera and Eleven New American Species. By Martin David Burkenroad. Pp. 109. (New Haven, Conn.)

Field Museum of Natural History. Botany Leaflet No. 17: Common Weeds. By Paul C. Standley. Pp. 32. (Chicago.) 25 cents.

U.S. Department of Agriculture. Technical Bulletin No. 376: Habits, Life History and Control of the Mexican Bean Beetle in New Mexico. By J. R. Douglass. Pp. 46. (Washington, D.C.: Government Printing Office.) 5 cents.

Brooklyn Botanic Garden Record. Vol. 23, No. 4: Prospectus of Courses, Lectures and other Educational Advantages offered to Members and to the General Public, 1934–35. Pp. xi+211–246. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.)

National Research Council of Japan. Report, Vol. 2, No. 2, April 1932–March 1933. Pp. iii+71–144. (Tokyo.)

Report of the First Scientific Expedition to Manchoukou under the Leadership of Shigeyasu Tokunaga, June–October 1933. Section 2, Part 1: Report of Diggings at Ho-Chia-Kou, Ku-Hsiang-Tung, Kirin, Manchoukou. By Shigeyasu Tokunaga and Nobuo Naora. Pp. iii+119+7+42 plates. (Tokyo: Waseda University.)

Union Internationale de Chimie. Premier Rapport de la Commission Permanente de Thermochimie. Texte de W. Swietoslawski et L. Keffler. Traduction allemande de W. A. Roth; Traduction anglaise de L. Keffler. Pp. 32. (Paris: Union Internationale de Chimie.)

Tanganyika Territory: Department of Geological Survey. Annual Report, 1933. Pp. iii+60. (Dar es Salaam: Government Printer.) 2*s*. 6*d*.

Colony of Mauritius: Department of Agriculture. Eighth Progress Report, being the Fourth Annual Report of the Sugarcane Research Station, Mauritius, for the Year 1933. Pp. 53+8 plates. (Port Louis: Government Printer.)

Smithsonian Miscellaneous Collections. Vol. 91, No. 16: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—New Marine Mollusks. By Lois F. Corea. (Publication 3258). Pp. 9+3 plates. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of the Interior: Office of Education. Bulletin, 1934, No. 4: The Welfare of the Teacher. By Dr. James Frederick Rogers. Pp. v+69. 10 cents. Leaflet No. 38: Instruction in the Effects of Alcohol and Tobacco. By Dr. James Frederick Rogers. Pp. 7. 5 cents. Pamphlet No. 53: Statistics of High Schools in Larger Cities. By Carl A. Jessen; Statistical Work by Lula M. Comstock. Pp. 11. 5 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 738: Surface Water Supply of the United States, 1932. Part 12: North Pacific Slope Basins. B: Snake River Basin. Pp. vii+197. 15 cents. Circular 10: The McCoy Mining District and Gold Veins in Horse Canyon, Lander County, Nevada. Papers by F. C. Schrader. Pp. ii+13. Circular 11: Review of the Petroleum Industry in the United States, April 1934. Compiled by Hale B. Soyster, in collaboration with G. B. Richardson, R. W. Richards, Foster Morrell, H. C. Fowler, G. R. Hopkins, A. J. Kraemer, A. C. Fieldner and H. J. Struth. Pp. iii+50. (Washington, D.C.: Government Printing Office.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 90: Size-Limits for Fish and Regulations of the Meshes of Fishing Nets; Reports of the Proceedings of the Special Biological Meeting held on June 4th and 8th, 1934, at Copenhagen. Pp. xv+61. (Copenhague: Andr. Fred. Høst et fils.) 3.00 kr.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 109: Magnetic Pressure-Indicator for Internal-Combustion Engines. By Tatuo Kobayasi and Sumio Sakuma. Pp. 35. 30 sen. No. 110: On the Characteristics of Microphones, Part 1: The Amplitude and Frequency Characteristics. By Kôzi Satô, Heizi Kawai and Rinzi Tate. Pp. 37–61. 25 sen. (Tôkyô: Koseikai Publishing House.)

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 20: Die Länge der Versuchsbasis von Helsinki und Längenveränderungen der Invardrähte 634–637. Von Ilmari Bonsdorff. Pp. 41. (Helsinki.)

Carnegie Institution of Washington. Publication No. 448: Chan Kom, a Maya Village. By Robert Redfield and Alfonso Villa R. Pp. viii+387+16 plates. (Washington, D.C.: Carnegie Institution.)

Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersökning år 1932. Pp. 62. Svenska Hydrografisk-Biologiska Kommissionens Skrifter. Ny serie, Hydrografi 11: Observations de courants dans la Baltique 1931. Par T. Gustafson et B. Otterstedt. Pp. 12+xvi. (Bornö.)

CATALOGUES

Ephedrine B.D.H. Pp. 10. (London: The British Drug Houses, Ltd).

The Newton British Made Epidiascopes. Pp. 20. (London: Newton and Co.)

Sands, Clays and Minerals. Vol. 2, No. 11, August. Pp. 124. (Chatteris: Algernon Lewin Curtis.)

Dawson's Periodica. (Catalogue N.S. No. 15.) Pp. 28. (London: Wm. Dawson and Sons, Ltd.)

Watson's Microscope Record. No. 33, September. Pp. 24. (London: W. Watson and Sons, Ltd.)

SATURDAY, NOVEMBER 3, 1934

No. 3392 Vol. 134

CONTENTS

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The Ordnance Survey and National Needs

THE ultimate value of a map or plan is measured by the accuracy with which it records the features of the area covered. It follows, therefore, that when development of an area is rapid, frequent revision of large-scale plans is necessary. For some time past, it has been a source of complaint that the large-scale plans of Great Britain are obsolete, and in July last the International Congress of Surveyors passed a resolution requesting the Chartered Surveyors' Institution to investigate the questions raised by this condition of many Ordnance maps of the British Isles and to take appropriate action. At a meeting of the council of the Institution held on October 8, it was decided that the Institution should proceed with a full inquiry into the present position, with the view of asking the Ministry of Agriculture and Fisheries, to which the Ordnance Survey is responsible, to set up a departmental committee to consider the subject.

The most important of the large-scale plans prepared by the Ordnance Survey are the plans on the scale of 1 : 2,500, that is, about 25 inches to the mile, and the 6-inch plans. There are larger town-scales, but their case is a special one and it would only confuse the issue to discuss it now. We propose, therefore, to deal only with what used to be a great national asset, the plans of Great Britain on the scales of 25 inches and 6 inches to the mile. There was no country in the world which, before the War, had such a remarkable series of large-scale maps on sale to the public. The 25-inch plans covered the whole surface of the country except waste and mountainous areas, and the 6-inch plans covered the whole surface, without exception.

The numbers involved were large ; the area of Great Britain being about 88,000 square miles, and each 25-inch plan covering a square mile and a half, the number of these plans is of the order of 60,000—actually somewhat more. In the same way the number of 6-inch quarter-sheets is of the order of 15,000, since each quarter-sheet covers an area of six square miles. It has been calculated that the human labour put into the surveying of Great Britain on these scales is considerably greater than would be required to map the whole of Canada or Australia on the scale of 1 inch to the mile.

The 6-inch survey of the six northern counties

of England and of part of Scotland was authorised in 1840, but it was not until 1856, after much discussion in and out of Parliament, that the 25-inch scale, with reduction to 6-inch (also to be published), was approved by Parliament. By 1891 the whole of the 25-inch plans of Great Britain, except those of Yorkshire and Lancashire and a few counties of Scotland, were completed by the Survey, and the first revision of the plans was begun.

It was now very wisely laid down that there should be periodical revisions of the large-scale plans, and that these revisions should take place every twenty years; the intention being that, in the future, no plan should be on sale to the public which was more than twenty years old. The revision proceeded systematically; a second revision was begun in 1904, and this continued until the outbreak of the War. So far, the public had no reason to be dissatisfied with the out-turn of the Ordnance Survey. The large-scale plans were kept reasonably up to date, and for certain public purposes, such as land registry and land valuation, special revisions were undertaken.

The War naturally stopped the even course of the revision. The civilians of military age on the Survey joined the Forces, the Royal Engineers were sent to units in France and elsewhere, and the main activities of the Survey were directed to co-operating with the survey battalions on the Western Front and to producing the very large numbers of maps which were used by the troops on the various fronts. Altogether more than thirty-two millions of war maps were printed by the Ordnance Survey during the four years of war.

Arrears of revision naturally accumulated during the War; but with a small increase of staff and a little re-arrangement of duties, arrears would have been overtaken, and the country would have had the plans necessary for its post-War development. But what actually happened was very different.

As the result of the report of the Select Committee on National Expenditure of 1918, a system was approved by which those counties having a population of less than 100 per square mile should be revised only once in forty years, instead of twenty years. Only one county in England was affected, namely, Westmorland, and in Scotland and Wales only the mountainous counties and the islands. This measure would not materially have detracted from the value of the national maps to the State or to the public, and, looking back upon the past, one cannot but feel that it was unfortunate that this decision was not allowed to stand.

Four years later, however, there came the report of the Committee on National Expenditure of 1922, better known as the Geddes Committee. That Committee recommended a further slowing down of the revision, so that revision would be carried out only in boroughs, urban districts and those areas which had undergone considerable change since the last revision. This additional restriction resulted in a diminution of the staff of the Ordnance Survey by 143 men; it effected a saving of about £30,000 a year; and it has been the principal cause of the troubles that were to come.

During the twelve years which have passed since the report of the Geddes Committee was issued, many changes have taken place in the surface of Great Britain. Some of these changes could not have been anticipated by that Committee, or, indeed, by anyone else. We have witnessed a vast extension of that unpleasant feature, 'ribbon development'; we have seen radical alterations in our road system; we have seen an unfortunate increase in our miserable 'conurbations'; and, to quote from an admirable publication recently issued by the Ordnance Survey*, "Judging from our recent plans there has been more change in Great Britain in the period 1922–1934 than in the whole of that period which elapsed between the start of the first revision (1891) and 1922". "When we are able to resume a more active revision we shall be faced with causes such as the following. Scunthorpe, in Lincolnshire, was last revised when a population of 6,750 covered 1,031 acres. It has now a population of 33,761, and covers an area of 7,895 acres". And so the story continues.

Moreover, it is not as if the type of revision remained the same as it was in pre-War days. Partly owing to the longer interval, and partly owing to the changes above indicated, revision of the national plans is a far more laborious matter than it used to be; it takes longer, and, of course, costs more. It appears, from the publication alluded to, that whereas, with approximately the same staff, about 2,050 plans were revised in 1923, it was only found possible to revise about 500 in 1933. Or the matter may be put like this: in 1923 a 25-inch plan took about 12 man-days to

* Ordnance Survey. Professional Papers, New Series, No. 16: The National Plans (The Ten-foot, Five-foot, Twenty-five-inch and Six-inch Scales). By Brigadier H. St. J. L. Winterbotham. Pp. 112+27 plates. (London: H.M. Stationery Office, 1934.) 4s. 6d. net.

revise, whereas in 1933 it took about 77 man-days. We shall probably be within the mark if we say that a plan costs something like four times as much as it did ten years ago.

It is certain that under the present Director-General and under his predecessor, every possible step was taken to expedite the work of revision; but the task was impossible with the exiguous staff allowed. We are, indeed, being deprived of a great and valuable heritage, the magnificent series of large-scale plans of our country, and if matters are allowed to continue in their present course, the Ordnance Survey plans will lose most of their value to the public. We are not making the best of the large capital expenditure that former generations have contributed to this eminently practical, national institution, and we are not providing in a reasonable manner for the needs of our successors.

The national plans enter intimately into all our social and official activities. They are almost invariably used for the conveyance of property, for land registration, for valuation, for a hundred different engineering purposes, drainage, water and electricity supply, the construction of roads and railways, in the daily work of local government, in town-planning, for the compliance with many recent acts of Parliament, and for innumerable private purposes. At the present time, these plans are so sadly out of date that local authorities and private persons have, perforce, to make maps of their own, maps of much less reliability. The secretary of the Chartered Surveyors' Institution has rightly said that we are not making proper use of the accumulated and co-ordinated knowledge of the Ordnance Survey, that expenditure is often transferred "from taxes to rates, maps less technically excellent are likely to be produced, while even these cannot be reproduced in quantity" and, "What our institution wants to see is a return to centralised map-making by the highly competent Ordnance Survey".

It is not too late to profit by this advice, but the situation is becoming serious. If the Government will examine the question, and will take evidence as to the harm which is being done by the failure to bring the plans reasonably up to date, if it will give serious attention to the difficulties which are being caused by allowing the large-scale surveys of Great Britain to fall into such disrepair, then we feel sure that the small additional annual sum required to bring them into a satisfactory state will not be refused.

Rock Engravings in Central South Africa

The Rock-Engravings of Griqualand West and Bechuanaland, South Africa. By M. Wilman. Pp. xii+78+70 plates. (Cambridge: Deighton Bell and Co., Ltd.; Kimberley: Alexander McGregor Memorial Museum, 1933.) 25*s*. net.

THIS substantial volume by Miss Wilman, keeper of the fine Museum at Kimberley, is the result of a quarter of a century's work, made possible by the financial assistance of the Royal Society of South Africa, and published by the Carnegie Trust through their great research branch in South Africa. The volume is far from being a complete survey of the rock engravings of South Africa, but rather the fruit of excursions round Kinderham, made chiefly during week-ends, with the addition of numerous documents by kindly collaborators.

Miss Wilman starts with a historical list of previous publications on the subject. A tale brought back by Moffat from Bechuanaland: animals and men issued from a cave where their footprints can still be seen (1842); A. Dolman (Bechuanaland, 1849); T. J. Andersson ("Traces of Men and Animals near Bloemhof and Taungs", 1866); Hubner ("Animals and Trees"); E. J. Dunn and G. W. Stow also wrote on the subject. Emile Holub, a Czech and doctor at Kimberley, made a big collection of engravings, now assembled in the Museums of Prague and Vienna and recently published by Zelisko—Miss Wilman is apparently unaware that a large selection of these was reproduced in 1905 by E. Cartailhac and H. Breuil in "La Caverne d'Altamira". Christol, Péringuey, Johnson and Rudolf Pöch all contributed to the subject; it was they who suggested the importance of the patina in determining the relative chronology of engravings, and also noted that, from A.D. 1000 onwards, the Hottentots had introduced a dog and a sheep of Syriac origin into South Africa. The author also alludes to the more recent researches of Mlle Weyersberg, Lebzelter and Dart.

In Chap. ii, the distribution of the open air engravings is described, and their relation to the paintings.

Péringuey, Maák and Halls wrote of painted engravings; sometimes these are paintings scored by a sorcerer, but Johnson described one engraving masked by a painting, and Miss Mannsfeld mentions another. A map shows the geographical extension of the engravings.

Chap. iii is devoted to the physical and prehistoric setting of Griqualand West and Bechuanaland. The wide schistous tableland of the Karoo, 4,000 ft. above O.D., is covered with sand and limestone tufa. Masses of boulders of diabase and

dolerite, sometimes scored and polished by the Carboniferous glaciers, form the kopjes at 4,200 ft. O.D. Here there are no rock shelters, but these exist in the dolomites and banded sandstones of the western region of the Kap plateau. As for the Kalahari, the sand covers nearly all of it. In that region, the winter is dry, and water must be dug for; but, in summer, the soil is saturated with it. The temperature varies from $-7\cdot5°$ C. to $+40°$ C.

The Stone Age is well represented, from the old handaxes of Stellenbosch to the small tools of Smithfield. The latter site has also a few microlithic implements, pestles, mortars, perforated stones, either small (beads and pendants), or belonging to digging sticks. Ostrich eggs provided water bottles and beads; there are leather water bottles and some bone or soapstone pipes. In the graves of the same age, there is unbaked pottery, plain cups ornamented with spots and elementary designs. As for the perforated decorated stones of Heilbron and the cylindro-conical objects from the same district, the author considers that neither they nor the stone rings are attributable to Bushmen. On the other hand, she considers a little sculptured human head in kaolinite, found at Kenilworth (Kimberley), as that of a Bushman: this, with some engravings on ostrich eggs, are the only small artistic objects found underground. Until 1875, the Bushmen children amused themselves by cleverly modelling animals in clay.

The stone circles, often very near the open air engravings, are the sites of contemporary huts, but, in the districts with high rocks, stairways leading upwards are cut in the rock, at places suitable for refuge or for the collection of wild honey.

The author then describes the engraved rocks of Griqualand West and Bechuanaland. So far, many are known in the Vryburg region and the upper and middle Vaal valley; they are more rare on the lower reaches of the Vaal, Riet and Orange Rivers. Miss Wilman divides them into four classes:

(I). The classic style of Péringuey: animals, men, plants, star-shaped and geometrical designs.

(II). Imitations of these, or re-engravings of them at a later date, very varied.

(III). Footprints of men and animals, sometimes associated with animals and snakes.

(IV). Recent scribblings.

This enumeration is followed by a digression on the amygdaloid diabases, bluish-black in colour with a quartz and chalcedony heart; with weathering, this rock becomes dark reddish purple. It is found either on river banks or high kopjes, from which a distant view is obtained. It is there that the engravings are found, and not in rock shelters or on isolated blocks; they are either scattered or concentrated, placed irregularly and sometimes in places which compelled the artist to take very trying positions.

Group I. In this class the line is obtained by pecking clusters of spots often arranged in series or loops. The line is rough and the same shade as the rock background. There are some lines from one quarter to three quarters of an inch wide, sketches of wild animals with very few details—their species and type are often doubtful; they are in profile, though not complete silhouette, for the four legs are given, even when they are joined two and two. In other engravings (really belonging to a second group) the pecked spots blend, thus becoming a continuous line, and sometimes the pecking covers the whole or part of the figure, giving details of the curves, coat, etc. The eye is often omitted (80 per cent are without eyes), and so is the ear, if it is not seen in silhouette. They are nearly always in profile, but some are foreshortened; their attitudes are living, and occasionally there are groups of animals, such as a lion and lioness, buffalo and wild dogs, etc.

Incised lines show the coat, the surface sometimes being polished afterwards with sand. There is also a mixture of pecking and grooving. Human figures are the most rare; some are armed with bows and arrows, but many are employed in peaceful, social occupations. It is seldom that their eyes are engraved. There are imaginary beings as well; semi-anthropomorphic or legendary animals; indeterminate plants (?), star signs, vague though careful drawings, and some compositions which might be meant for landscapes (?).

Group II (*really a third group*). In these, the outline was first drawn with a graver; then the surface was covered more or less completely with either coarse or extremely fine pecking. Some are very old and weathered, others very recent and light in colour. The naked human figures with exaggerated sex seem to be Bushmen; not many are steatopygous—only two men and three women amongst twenty-eight figures. There are very complicated scenes. Plants are rare; the author thinks the star-shaped patterns are flowers. There are fifty-two kinds of animals, including some reptiles, their size varying from an inch or two to 43 inches (elephant). A python seven metres long stretches across two neighbouring boulders. Animals which abound nowadays, such as hippopotamus, hartebeest and springbok are seldom given, other kinds of existing antelopes are absent. The most numerous are types which have left the district, or ceased to exist, such as the quagga. As small mammals, there are only the genette and the meerkat (*Cynictis*). Birds are rare, except the ostrich. There are none of the insects noted by

Holub and Zelisko, no mastodons, or big Equidæ, or pigs such as those the bones of which lie in the old gravels of the Vaal, no *Bubalus Baïni*, or the big hippopotamus of Windsorton. There are no domestic animals ; it is doubtful if there are dogs, and the Cape sheep, copied by Stow, is much later in style.

Certain engravings have been re-interpreted a second time, either at the same date or very much later (in the case of a rhinoceros, remade as an elephant), or they have been revived ; but the majority have remained untouched.

Another group are imitations of the classic designs or inspired by them. These are sometimes excellent, but mostly purely geometrical. They are often on old surfaces scored by carboniferous glaciers ; such as the symbols associated with various animals at Katlani and Driekops Eiland, the patina on which is the same as that of the background (and therefore very old.—H.B.). There are very numerous and excellently made geometric designs (I do not see why the author considers that these were suggested by or imitations of the engravings ; it is not proved by her description, and so this Group II may be perhaps as old or older than Group I ; as its geographical localisation is different, they cannot be due to suggestion or imitation ; so it had better be considered as the work of a different ethnical group).

Group III. Footprints of men and animals. These are direction signs pointing towards the places where there is water, or, according to another tradition, 'creation-sites', the footprints being those of the creatures, men and animals, who emerged for the first time from the mud near a water-hole. The author suggests that there is perhaps something of a rain-making rite here. She adds that the pictures of snakes were to mark the places where there was wild honey.

Group IV. Scribblings. These have no interest; they were made recently by the mixed races and whites (alas !).

The author, in the following chapter, studies the chronological order of the figures ; she does not trust much to the patina and only studies the few cases of direct super-position, citing the following instances :

1. Disconnected spotted lines of Group I are immediately below the line drawings of Group II and the filled-in ones of Group III.

2. A single line engraving is directly underneath a filled-in one of Group II.

3. A filled-in engraving, Group II, is below one with no contour line, Group III.

4. A partly filled-in engraving of Group II is immediately below another completely filled-in, Group II–III.

5. Many engravings in Group II emerge from beneath engravings of Group III. The "imitations", more or less contemporary with Group III, must have continued until recent times ; as for the footprints, they are partly very old, in some cases not so old, but never recent.

In the basin of the Riet River, the incised line engravings are older than all the "pecked" ones (Afvallingskop).

What is the age of these engravings ? According to Stow (1880), the most recent were only fifty years old, but the oldest (the symbols) had been there for several centuries. Holub said the most recent were a hundred years old, according to some Bushmen who were grandsons of the engravers, and the oldest more than six hundred years old. Péringuey, noting the total absence at Kinderham of oxen and sheep, considers them previous to the arrival of the Hottentots ; less happily, he dated them as contemporary with the Acheulean double-faced tools found at the same spot. An elephant, reproduced by Burkitt, was drawn before the days that Hottentots added on the older figure those of iron-tipped javelins. Lowe considers the engravings of Lower Smithfield and some others, as well as certain paintings, to be of Middle Smithfield date. Lang and I consider part of them much older. At Afvallingskop, which I have visited, there is no Smithfield industry, but much of various dates in the Old Middle Stone Age. Lastly, at Stowland, the industries are very abundant and almost all of Middle Stone Age date ; though it is true that some fairly good figures had been added there only a few days before our passage (1929).

After some remarks about the patina, the author accepts as date "many centuries" for the old ones, without further precision.

How were the engravings made ? Miss Wilman thinks with a diamond : I pointed out that, at Stowland, flakes of quartz and chalcedony had been used. Van Riet Lowe experimented with these and proved their efficacity.

Who made the engravings ? Not the painters. In Bechuanaland and South Rhodesia, engravings and paintings are near each other, but very different. The author praises the cleverness of the engravings and under-estimates that of the paintings, attributing wrongly (according to my ideas) the 'shading' to disintegration of the rock. The engravings are mostly geometric designs, flowers (?), trees, fewer humans rarely steatopygous, and yet fewer mythical groups and scenes. As a whole, the engravings seem older than the less ancient paintings, as they lack the battle or cattle robbing scenes of these latter.

The geographical distribution differs ; the engravings tend to be in Central South Africa, touching the region where there are paintings in Damaraland, Southern and Northern Rhodesia and

Bechuanaland, where there are few engravings but fine paintings.

The footprints of men and animals have a wider distribution, which, I think, tends to separate them ethnographically from the other engravings. In the actual Bushman country, there are neither engravings nor paintings; there are none in Zululand (Stow and McGregor), or in southern Bechuanaland. Large tracts of country have therefore neither one nor the other.

The author almost follows (except for Damaraland) the geographical divisions given by Stow. She thought the engravers came from the North via the central region, establishing themselves in the upper valley of the Harts and Vaal Rivers, pushing forward into Griqualand as far as Withbergen, and going south as far as Beaufort West and Newbergen.

The painters, however, must have followed the west coast and the midlands of Cape Colony, going upwards as far as the south of the Vaal, where they met the engravers, resulting in a certain combined technique in the Snoewberg: some painters went as far as Griqualand. The habits of the two groups differ; the painters were cave dwellers; the engravers lived in round huts on rocky hills.

What Stow writes about them, he learnt from Bushmen, and the Basutos tell the same story. He exaggerates the density of population in the Pniel and Half Way House (Kimberley) regions, and Miss Wilman corrects this, following Péringuey. She holds (and with reason) that there were fewer engravers at a time, and that the work occupied years and even generations. There must have been settled habitations near permanent waterholes, and at such sites there are many engravings; elsewhere they are only sporadic.

Were the engravers ||N Bushmen? Were the primitive engravers of the same race as the last of the engravers mentioned by Stow? The author thinks so, for the different styles of engraving blend one in the other (in the geometrical and footprint series, this can be disputed). She sees here the work of a single tribe, whose descendants spread over Griqualand and Bechuanaland.

According to Miss Bleek, the ||N Bushmen who lived on the Orange River had a different language from that of the Kam Bushmen of the Cape; they wore stone bracelets to give weight to the arm when throwing a javelin.

Should these engravings be considered pre-Bushmen? Without going as far back as the Acheulean industries of Kinderham, there is a Smithfield industry site there, and Van Riet Lowe recognised the association of Old and Middle Smithfield implements with engravings; Upper Smithfield and microlithic Wilton industries are found with the paintings. I have said, and think, that, for the date of some of the engravings, we must go back as far as the Middle Stone Age.

According to Broom, the human type of the Middle Stone Age is the Australoid Korana (though the Springbok man seems to me to contradict this); he attributes to them not only all the engravings, but also the pierced stone rings of the digging sticks, and he thinks, though I do not think this can be upheld, that the engravings have been made with metal. Miss Wilman contents herself with rejecting this attribution to the Koranas, they being too stupid and indolent.

Were not footprints frequently drawn by Australians, as well as a good many symbols and even some fairly well-made figures? Can one argue from the modern Koranas what their ancestors would be? Perhaps they did their share of the engravings and the Bushmen did the best ones. Civilisation, art and race are not synonymous; no doubt, this will be for long an open question.

What did the engravings mean? At Blow Bank, Stow noticed that the old geometrical engravings were not superposed, as were the more recent. He thought that, at the beginning, these drawings were sacred and respected, and remained so for a long time. Then, after a long interval, late copies were frequently made. Certain scenes seemed to him orgies; others hunting scenes, intimate scenes, masquerades and legendary subjects. A hippopotamus at Gams is drawn across dry ground with a rope by Bushmen; no doubt a rain-making scene?

Why are certain boulders covered with drawings (Afvallingskop), whilst others nearby, just as suitable, have nothing on them?

So far, the engravings have been fairly well studied on the Vaal, in Griqualand West at Pniel, Klipfontain, on the upper stretches of the Riet River, at Vereiniging, etc.; but no complete study has ever been made, no corpus published nor even classified, in spite of Miss Wilman's effort.

The technique and the subjects vary from one site to another. At Kinderham humans are associated with animals; elsewhere, the animals are alone. In other places, stars, trees and geometrical designs are side by side with animals and men. The animals vary at the different sites; there are no jackals amongst the engravings on the Vaal. In certain spots, geometrical designs predominate.

How many unsolved problems there are! Miss Wilman has at least made an objective contribution, profusely illustrated, to this entrancing subject; she adds some valuable observations, and we must congratulate her on not having delayed publishing what she knows and thinks, and be ready to discuss the one, and gratefully make use of the other.

H. BREUIL.

Prevention of War

The Intelligent Man's Way to Prevent War. By Sir Norman Angell, Prof. Gilbert Murray, C. M. Lloyd, C. R. Buxton, Viscount Cecil, W. Arnold-Forster, Prof. Harold J. Laski. Edited by Leonard Woolf. Pp. 576. (London : Victor Gollancz, Ltd., 1933.) 5*s*. net.

"THE last word of evolution is this : The race is not to the swift nor to the strong but to the wise." With these words Dr. W. Langdon Brown closed an address on biology and politics in which he indicated certain general biological principles which bear on the political difficulties arising in the present conflict between nationalism and internationalism. Among the gravest needs of to-day is that of more intelligence in our national and international affairs, and anything which directs attention to this need is welcome. Nowhere is this more essential than in international affairs, both in our attitude to, and in thinking about, problems of world peace. Despite the quickening pulse of preparations for war during recent months, all the evidence goes to show that the general will to peace is much more conscious and decided than before the War, and there is no reason to question the sincerity of that desire. The growing danger of war is due mainly to lack of intelligent thinking about the problems involved, to a mental lethargy which refuses to face the full facts and to our tendency to desire two mutually inconsistent things.

The first step to world order is taken with the realisation that competition in national armaments, in place of giving security, leaves the relative position unchanged, and in fact tends to decrease security through the distrust and suspicion it breeds between the nations. The most serious feature of 1933 was the marked tendency in some quarters to forget the lesson impressed on men's minds in 1918–20 and to slip back into the pre-War mentality just when the Disarmament Conference was in session.

The second step towards world order is taken when it is generally realised that national defence rests fundamentally on pooled security and is a collective and not an individual matter. This view is, of course, implied alike in the Covenant of the League of Nations and in the Pact of Paris ; but even now not only are the full implications of such a system imperfectly understood by public opinion but also there is a gnawing anxiety as to whether the pledges given in such treaties will be observed.

These are not matters to which the scientific worker can be indifferent. Without urging that this is a matter which is peculiarly his responsibility, it is undoubtedly one in which he bears special responsibilities, and the lucid and impartial exposition of the various factors contained in "The Intelligent Man's Way to Prevent War" merits indeed the thoughtful attention of all scientific workers. Fundamentally, the problem is one of education, and the uncertainty whether the educational work can be completed in time to avoid disaster only emphasises the need for wholehearted support from the scientific worker.

As Dr. W. Langdon Brown pointed out in the address referred to above, while we are developing the need for larger and larger units in our social and industrial life, we are slow to restrict the impulses which tend to destroy such units. If we fail to adapt ourselves to the demands of evolution our civilisation will undoubtedly perish, and political events in 1933 do not encourage undue optimism. If, however, from an intellectual point of view there is reason for concern, biological considerations encourage optimism. The ease with which the body can throw off disease and return to health should safeguard us against the hasty belief that events in Japan or Germany, for example, inevitably presage a relapse into barbarism.

Moreover, the problem of security and disarmament, of world peace, is less technical than is commonly supposed. There are important technical factors, it is true, and there are problems to which the man of science can and should make an important specific contribution. What is even more important, however, is to destroy the feeling of mystery with which science is commonly surrounded, and by aiding ordinary intelligent people to appreciate the principles of science, to encourage the application of them to the everyday problems of a modern community. The enthronement of reason in place of prejudice thus secured would not mean the tyranny of experts, but would ensure that rational conduct of international affairs which would at once eliminate war. This point is well brought out by Sir Norman Angell in two chapters on "The International Anarchy" and on "Educational and Psychological Factors" which are among the most valuable in the book. They are to be commended to the scientific worker more than even Prof. Gilbert Murray's expert analysis of the possibilities and problems involved in revision of the peace treaties, Viscount Cecil's study of the League as a road to peace or W. Arnold-Forster's admirable discussion of the interlocked problems of arbitration, security and disarmament. Understanding of the issues there must be, but, above all, there must be action along the lines upon which the experts have already agreed that security and progress are possible.

R. BRIGHTMAN.

Short Notices

Dip and Strike Problems Mathematically Surveyed. By Dr. Kenneth W. Earle. Pp. x+126. (London: Thomas Murby and Co., 1934.) 12*s.* 6*d.* net.

IT is not stated whether this book is intended for use as a textbook, although on perusal this seems to be the case. It would perhaps have been preferable to mention the degree of mathematical knowledge desirable in the reader; some of the workings given in the earlier portions are detailed, while later portions omit stages in the calculations, and in this way difficulty might be caused to students who seldom use plane and spherical trigonometry. The working on page 9, from which formulæ for finding the true dip of a bed from three points of outcrop are derived, would be easier to follow had a figure been appended.

The worked examples are extremely useful and clear, and are essential to an understanding of the use of the formulæ. The term "secondary tilt" might perhaps have received more detailed definition, and here also a figure would be useful. Some of the formulæ deduced for use in problems connected with borings are somewhat cumbrous, notably No. 64, and would take some little time to work out even by slide rule. It may also be doubted whether it is worth while calculating dips to minutes of arc, having regard to the manner in which dips change in the field in quite short distances, even in districts which have not been materially affected by major earth-movements.

One of the best chapters is that dealing with faulting. The figures here are well set out and informative, and the treatment is exceptionally clear in style. The glossary of structural terms which concludes the volume is also very useful, though it would be difficult to follow some of the definitions given without a fair knowledge of structural geology.

B. H. K.

Differential Equations. By Prof. H. B. Phillips. Third edition. Pp. vi+125. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 10*s.* 6*d.* net.

To conform with modern teaching practice, the text of this book has been carefully revised and a few new sections added. The treatment is essentially practical and designed to provide a working basis for the scientific student. There are four chapters; two devoted to equations of the first order, one to the special types of second order equations most frequently occurring in practice, and one to linear equations having constant coefficients. The theoretical aspect has not been wholly ignored, and, though inadequate for the needs of purely mathematical students, sufficient is discussed to give an intelligent grasp of the principles underlying the solution of differential equations. The text is well illustrated by worked examples drawn mainly from mechanics, chemistry, engineering and physics. Plenty of exercises are also provided for the student to solve. The notation 'ln' for '$\log_e$' will probably be somewhat strange to British readers.

Analytic Geometry. By Prof. F. S. Nowlan. Second edition. Pp. xii+352. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 13*s.* 6*d.* net.

THIS volume is the second edition of the original book, published last year. It is designed for first and second year students in American and Canadian universities. Eleven chapters are devoted to a study of the conics, based upon a definition of the general conic, and in which extensive use is made of the principle of orthogonal projection. Parametric representation is freely employed, but the proof that the general equation of the first degree always represents a straight line is not thoroughly satisfactory.

There is a good chapter on higher plane curves, followed by quite an exhaustive treatment of determinants, which seems to come rather late in the course. Indeed, as a study of determinants belongs properly to algebra, a brief revision section at the beginning should have been sufficient.

The remainder of the book is concerned with the usual course in three-dimensional co-ordinate geometry, and is quite well written and developed.

Budgerigars in Bush and Aviary. By Neville W. Cayley. Pp. xv+148+14 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1933.) 7*s.* 6*d.* net.

ABOUT one hundred years ago budgerigars or love-birds were first bred in captivity in Australia; in 1840 Gould brought the first living examples to Britain, and by 1880 their breeding had become a considerable industry at Toulouse. But it was not until the present century that the burst of colour-varieties appeared, which made the budgerigar perhaps the most striking example of selection under domestication, and brought for a time the value of birds (in the sky-blue and cobalt series) to from £100 to £500 a pair. This book, with its six beautiful coloured plates, will probably long remain the standard guide to the habits and particularly to the keeping and breeding of these attractive birds.

The Nidification of Birds of the Indian Empire. By E. C. Stuart Baker. Vol. 3: *Ploceidæ—Asionidæ.* Pp. vi+568+8 plates. (London: Taylor and Francis, 1934.) 30*s.*

WITH commendable speed Mr. Stuart Baker's third volume follows the second (see NATURE, April 21, 1934, p. 591). Beginning with the weaver-birds, it completes the Passeres and the Coraciiformes, and some idea of the thoroughness with which the nesting of Indian birds has been investigated (as well as of blanks still remaining) may be gathered from the fact that of 704 species and subspecies included in these series, the nidification of 545 is here recorded. Like the earlier volumes, this also includes descriptions of some extremely interesting nests and their construction, of which we need mention only those of the weaver-birds, the bee-eaters, and the edible-nest swiftlets. The work is as thorough and comprehensive as its predecessors.

The John Murray Expedition to the Arabian Sea

By Lieut.-Col. R. B. SEYMOUR SEWELL, C.I.E., F.R.S.

IN my previous accounts of the John Murray Expedition (NATURE, 133, 86, 669, Jan. 20 and May 5, 1934), I dealt with the work done up to the time of our arrival in Colombo on February 22, and in the present paper I give an account of the concluding part of our voyage. While in Colombo, we were joined by Major E. A. Glennie, R.E., of the Survey of India, and his staff, who had been detailed to accompany us through the Maldive Archipelago and carry out observations on the variation of gravity by means of pendulum experiments. Leaving Colombo on March 17, we steamed south-west to a point just north of the Chagos Archipelago, and then turned northward to investigate the depth and hydrographic conditions existing in the channel between the Chagos and Maldive groups of islands. On the completion of this work we visited Addu atoll, and Major Glennie and his apparatus were landed on Putali Island at the north-east corner of the atoll. After leaving Addu atoll we steamed northwards to South Malé atoll, landing Major Glennie on the way at Kolumadulu and Mulaku atolls.

At South Malé atoll a formal visit was paid to H.H. the Sultan, who very kindly placed a boat at the disposal of the Expedition and thus enabled me to detach a party, consisting of Major Glennie and Lieut.-Commander Farquharson, R.N., to carry out pendulum and magnetic observations in a line across Fadiffolu and South Malosmadulu atolls, while the *Mabahiss* was engaged in hydrographic and biological work in Kardiva Channel and on the western slopes near Horsburgh atoll. During the course of this work, we discovered the existence of a submerged bank, to which we have given the name "King Fuad Bank", lying at a depth of 130 fathoms, and occupying the greater part of the western end of Kardiva channel between Horsburgh atoll and Toddu Island. After ten days we picked up our detached party and proceeded northwards to Minikoi, where Major Glennie was again landed for pendulum observations. On the conclusion of this work we returned to Colombo for coaling and left again, on our return voyage to Aden, on April 19. After passing through Kardiva Channel and running a further line of soundings across King Fuad Bank, we set our course westward, approximately along lat. 7° N., until we were in about long. 58° E., when we altered course and, passing between Cape Guardafui and Socotra, again entered the Gulf of Aden. Having repeated the hydrographic observations across the mouth of the Gulf at a series of stations as near as possible to those that we made in September and October, 1933, and having made several hauls with the trawl or dredge on both sides of the Gulf, we called in at Aden and on May 13 left for Alexandria, repeating a number of observations that we had made at the head of the Gulf and at the southern end of the Red Sea on our outward journey eight months previously. We reached Alexandria on May 25, and the ship was paid off on the following day.

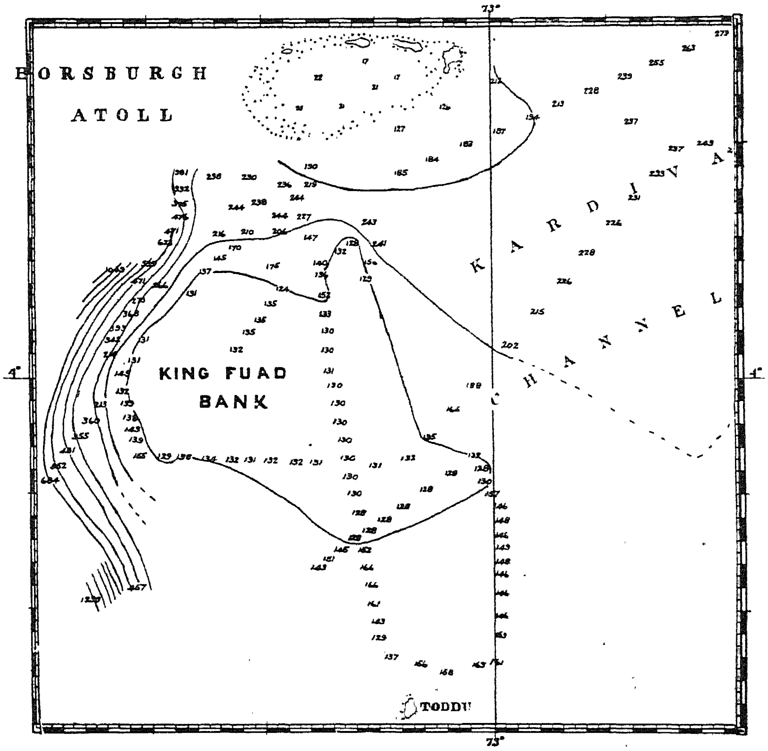

FIG. 1. King Fuad Bank at the western end of Kardiva Channel, Maldive Archipelago.

TOPOGRAPHICAL RESULTS

On leaving Colombo on our voyage to Addu atoll, we first crossed a deep gully, of about 2,200 fathoms depth, that runs north-west near the south-west corner of Ceylon, and then the depth shoaled again. The greatest depth encountered between

Ceylon and the channel between the Maldive and Chagos Archipelagoes was about 2,500 fathoms, but as we approached the Archipelagoes the depth shoaled rapidly until we were in about 1,500–1,600 fathoms, at which depth the bottom remained fairly constant for some distance. In the channel itself the depth of water appears to be in the neighbourhood of 2,000 fathoms with, apparently, a hard bottom, since two attempts to obtain a bottom sample yielded no trace of any deposit.

I have already referred to the discovery of a submerged bank (Fig. 1), situated at the western end of Kardiva channel, and occupying most of the gap between Horsburgh atoll and Toddu Island, to which I have given the name "King Fuad Bank". On the north-east side this bank rises very steeply from some 240 fathoms, the general level of the channel, to about 130 fathoms, while on the western side the bank drops steeply down to 1,000 fathoms or more. The surface of the bank is flat and around part of the margin runs a raised rim on which the depth of water is about 125 fathoms. There can be little doubt that this is a submerged atoll, that still shows clearly the flat lagoon floor and, in places, the raised marginal reef.

As we steamed westward in our voyage from Colombo to Aden, the soundings to the westward of the Maldives showed a series of folds, succeeding each other regularly, the depth varying from 2,800 to 2,000 fathoms. These soundings agree with those taken by us between the Seychelles and the Maldives, but in this more northerly section the range is considerably greater. The eastern edge of the great ridge that runs towards the south-east from Socotra, and to which Schmidt has given the name Carlsberg Ridge, was encountered in lat. 7° N., long. 61° 30′ E. Here again there seemed to be indications of a double ridge, for we obtained a sounding of 1,361 fathoms which seemed to correspond with the 958 fathoms sounding obtained between the Seychelles and the Maldives; the soundings then dropped to 1,840 fathoms and in lat. 7° N., long. 60° E. a second ridge of only 1,209 fathoms depth was crossed. Shortly after this the ship's course was altered to north-west-by-west. This course was considered to be only a few degrees divergent from the general direction of the ridge, and the soundings for the next fifty minutes fluctuated between 1,230 and 1,340 fathoms with occasional deeper depths. For the next 230 miles the ship was approximately steaming along the 2,000 fathom line, with variations on either side, to lat. 9° 20′ N., long. 55° 15′ E., when the soundings dropped steeply to 2,500 fathoms and remained fairly constant until we reached the Guardafui–Socotra channel.

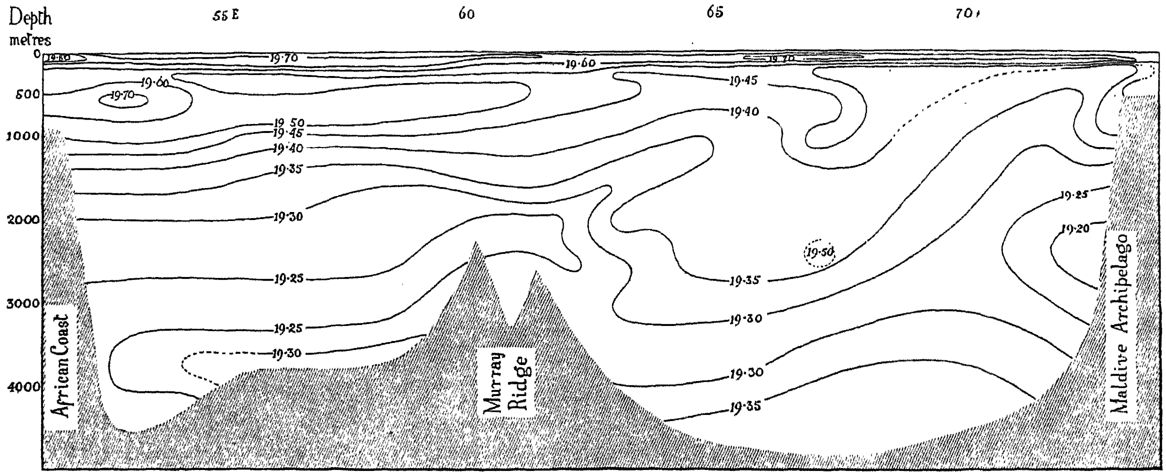

FIG. 2. Halogen content of water between Kardiva Channel and Cape Guardafui.*

A number of samples of the bottom were obtained. In the north-eastern basin, we obtained a long core, 52 inches, of soft reddish-cream ooze, and from a deep trawl in lat. 6° 55′ 18″ N., long. 67° 11′ 18″ E., depth 4,718–4,793 metres (Station 166) we obtained 125 kilograms of rounded or angular nodules, containing manganese, of varying sizes, but there were no signs of any living organisms, though the net was on the bottom for two hours. Sir John Murray himself many years ago directed attention to the character of the bottom deposit in this region, lying between lat. 5°–12° N. and long. 62°–72° E., which must be classed as a "Red-Clay".

On the Carlsberg Ridge itself, in lat. 7° 14′ N., long. 60° 38′ 42″ E., depth 3,182 metres (Station 168), the bottom was rocky; the trawl frame was bent and broken and the net torn, but we obtained a few fragments of foraminiferal limestone.

* It was originally intended to call the ridge between the island of Socotra and the Chagos Archipelago the "Murray Ridge"; but it has since been discovered that Dr. J. Schmidt, who crossed it in the *Dana*, had already named it the "Carlsberg Ridge".

While passing through the Straits of Bab el Mandeb and the area to the immediate north in the region of Great Hanish Island, we again obtained clear evidence of the formation of a calcareous rock on the bottom, and in lat. 15° 54′ 36″ N., long. 41° 13′ E., we brought up large quantities in the four-foot triangular dredge, mixed with a greenish-brown mud that contained large numbers of pteropod shells.

HYDROGRAPHIC RESULTS

During the run across the Arabian Sea a number of hydrographic observations were taken, and a preliminary survey of these observations indicates a complicated circulation of the deeper water masses. The results of the analysis of the halogen content of the water are shown in Fig. 2, and it is interesting to compare this with the figures that I have given in my previous report of the results obtained in our earlier crossing of this region between Bombay and Mombasa (NATURE, 133, 700, Figs. 2 and 3).

The surface water, having a halogen content of 19·60 and above in the western and central area, is moving in an easterly or south-easterly direction sinking somewhat as it goes, until in long. 61° E. it disappears below the surface and is continued at a depth of some 50 metres. Below this, at 300–400 metres, there seems to be a westerly movement of water of a somewhat lower halogen content, 19·5 and less, that can be traced as far as long. 55° E. The main mass of water of halogen content of 19·6 and above, coming out of the Gulf of Aden between the depths of 400 and 800 metres, appears to swing towards the south and passes partly between Cape Guardafui and Socotra but in the main to the east of the island, while farther east between long. 55° and 62° E. a tongue of water, having a halogen content of 19·52–19·53, is moving in a south-east or easterly direction. In the south-west basin a mass of water of a halogen content of only 19·21 occupies the greater part of the deep area, and appears to be moving east and north-eastward until, meeting with the Carlsberg Ridge, it is deflected, part passing over the ridge into the north-east basin and part being deflected upwards towards the surface. There can be little doubt that this water of low halogen content is derived ultimately from the Atlantic bottom-drift that probably enters the south-west basin between the Seychelles and Madagascar.

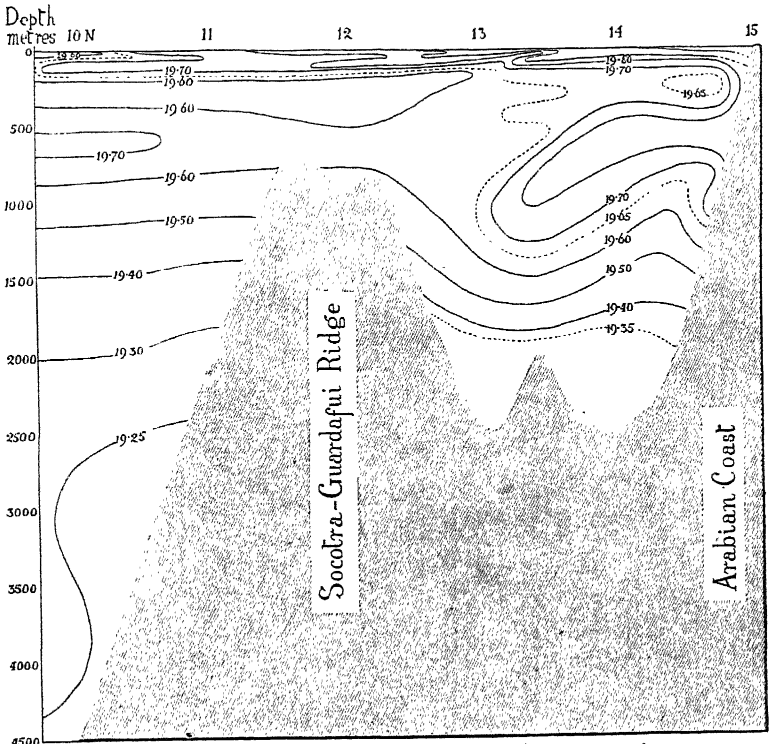

FIG. 3. Halogen content of the water of the Socotra current.

In the north-east basin the surface water appears to be forced downwards, and at a depth of some 700 metres is split into two streams, one passing towards the west, where we have already seen it forming a stratum at a depth of 300–400 metres, the other sinking downwards until it meets the eastern slope of the Carlsberg Ridge and is then deflected first eastwards, and then upwards towards the surface. The south-east part of the basin in long. 72° E., between the depths of 2,000 and 3,000 metres, is occupied by a mass of water of low halogen content, 19·25 or less, that must, again, be derived from the antarctic bottom drift, and probably enters the basin between the Maldives and the Chagos Archipelagoes, where there is a deep channel of some 2,000 fathoms (3,600 metres) depth. Below this depth the bottom of the basin appears to be occupied by water of a somewhat higher halogen content, 19·30 and above, the sample from extreme 4,000 metres depth having a content of 19·34 and at 4,500 metres of 19·83, though this last figure is open to suspicion. In long. 67° 11′ E., at a depth of 2,500 metres a mass of water was encountered having a halogen content of 19·50, while the reading at 2,000 metres was 19·36 and at 3,000 metres 19·28. It is possible that this is the continuation of the outflowing water of high

halogen content from the Gulf of Oman, that has gradually sunk downwards off the west coast of India and the western slopes of the Laccadive and Maldive Archipelagoes.

The results obtained by repeating our observations in the Socotra current across the entrance to the Gulf of Aden show a considerable degree of similarity with those obtained during our earlier work in September (cf. NATURE, 133, 67, Fig. 3 and 87, Fig. 2). In the Straits of Bab el Mandeb, however, conditions were very different and now (April–May) agree closely with the results previously obtained by the *Magnaghi* and *Ormonde* at this time of the year.

BIOLOGICAL RESULTS

During our cruise through the Maldive Archipelago a number of observations were made, both in the shallow water of the lagoons and in the deeper waters of Kardiva Channel and the western slopes.

Station No.	Locality	Depth (metres)	Nature of bottom	Amt. of H_2S (mgm. per litre)
137	Addu atoll, N.E. corner	46	White, chalky mud	4·90
139	Kolumadulu atoll, E. side	57	Coral sand	nil.
141	Mulaku atoll, W. side	44	Coarse sand, shells, coral and conglomerate rock	nil.
142 (a)	Fadiffolu atoll, E. side	31	Sand and white mud	3·29
142 (b)	ditto.	37	Cream-coloured mud	2·26
144	Fadiffolu atoll, W. side	31	Coarse coral and shell sand	nil.
147	Horsburgh atoll, N. side	27	Soft cream-coloured mud	nil.
160	Horsburgh atoll, N. side	37	Cream-coloured mud	7·73
161	S. Malosmadulu, W. side	46	Coarse sand	nil.

One interesting and important discovery that we made was the presence of sulphuretted hydrogen gas in the bottom-deposit of several of the lagoons. The details are given in the accompanying Table.

It will be noted that in every case the presence of the sulphuretted hydrogen is associated with a fine white or cream-coloured mud, and in most cases where the gas was found there were thickly wooded and fertile islands in the near vicinity, so that it seems probable that this gas is caused by the decomposition in the mud of organic material derived from the vegetation of the islands. To what extent the presence of this gas, in such quantities as are indicated above, may influence the fauna or inhibit the growth of coral is a problem that requires investigation.

A slight trace of sulphuretted hydrogen was also detected in a bottom deposit of green mud, obtained at a depth of 95 metres, on the Arabian coast in lat. 13° 51′ 30″ N., long. 47° 49′ 12″ E. (Station 189) in the Gulf of Aden, and this possibly represents a western extension of the conditions found to be present farther to the east off Cape Ras-al-Hadd.

The fauna of Kardiva Channel and the flat level of King Fuad Bank proved to be a rich one, but on the western slopes the catches were disappointing. This may be due partly to the difficulty of trawling successfully on a steep slope, but it would also appear probable that on this western side of the Maldive ridge the fauna is impoverished, and in the depth of the north-eastern basin of the Arabian Sea a trawl of two hours' duration on the Red Clay at a depth of 4,718–4,793 metres yielded no living organisms at all.

The Green Plant and its Messages to Mankind*

IN this clanging world of constant change, one thing stands fast: the green plant, the greatest wonder of the world, the engineer of life. Some of its messages it sends direct to us by its own special messengers, for example, the vitamins; others it leaves scientific interpreters to convey. The green plant is the source of the paper upon which the latter messages are written, and when the paper perishes, the plant gathers up the fragments and welds them again into leaf and flower and fibre. It is also the source of coal, of wood, of dyes, spices, fabrics and wine.

The life of the simplest of green plants, *Chlamydomonas*, tells us of feats of structural engineering beyond human power, and suggests hydraulic systems so perfect that, in spite of its fragility, the green plant can sustain pressures comparable with those of the steam-engine, and that too without shriek or moan. The individual *Chlamydomonas* is invisible to the naked eye, yet so numerous that at certain times they form a green scum on the edge of the sea and on inland waters. *Chlamydomonas* is a plant-animal. In its green youth it is active and self-contained; the only materials for its sustenance are solutions of carbon dioxide, simple nitrogen compounds and mineral salts. From these it builds up sugar and starch by photosynthesis, and amino-compounds and proteins with the help of oxygen derived from nitrates in the sea-water. A powerful swimmer for its size, it propels itself by means of long, slender protoplasmic threads towards the light. But these 'salad' days come to an end. The solitary swimmers unite by fusion, protoplasm with

* Summary of the Thomas Hawksley lecture, "The Green Plant as Agricultural Engineer", given by Sir Frederick Keeble before the Institution of Mechanical Engineers on October 26, 1934.

protoplasm, nucleus with nucleus, and the spherical product settles down on some debris in shallow water. The chlorophyll steals away, and what was before a plant is now an animal, depending, like all animals, on external supplies of food. Its body grows, subdivides, and the parts subdivide again, flagella appear, and the plant-form of *Chlamydomonas* is born anew. The message to mankind is patent to all : "The green plant makes the best of both worlds ; go thou and do likewise !"

Whatever man may have done with his own world, he certainly has not made the best of the other world—the world of the green plant ; if he had, his own would be far brighter and happier. What has he done for the green plants' world ? By incessant labour he has made little plots of earth more fruitful ; but invading armies and marauding bands have laid waste great tracts of fertile land. He has changed weeds into bountiful cereal crops, has ravished virgin soils, only to move on and let the weeds come back again. He has felled forests and burned them down, until the earth which the forest used to shelter is driven by storms of rain to seek refuge in the sea. Man by his intelligence and industry has done much for the green plant, but by his ignorance and improvidence he has done far more for its undoing.

The green plant makes a brave show, clothing the earth with verdure and adorning it with garlands of flowers ; but in the main it leads a life of poverty. The sun gives it abundant energy ; earth and atmosphere are, however, more niggardly. In spite of the ample amount of carbon dioxide in the air, its concentration is too low to allow the green leaves to keep up their full synthetic powers. Wheat is pre-eminent as a thrifty plant, and will stand a fair amount of neglect. That is why it is grown so universally, and why, grown even as it is, the crop feeds some 300 million people. The kinds mostly grown can withstand rough weather and get along with scanty supplies of food. Inured to hardship like the farmer himself, they respond but grudgingly to more generous treatment ; but some kinds respond to nitrogen more readily than others. The wheatlands of the world could feed thrice 300 million people if they were relieved of chronic hunger for nitrogen and phosphates. The grasslands of the world are even more hungry, and the landscape often reveals their poverty. Grass makes a brave showing, which adversity cannot mar ; but the brave show is brief. The short life of the grass growing on the thin soils of the Cotswold hills was observed by Shakespeare, as we observe it to-day, and he must have had this fact in mind when he wrote : "Everything that grows holds in perfection but a little moment."

The green plant, schooled by age-long privation, has grown adept in the arts of economy. It builds up nitrogen into organic form, breaks it down again, and sends it off to other tissues that need it. These tissues build it up again into protein, only to unbuild it and pass it on once more, like some old garment that is renovated and handed on in thrifty families from the eldest to the youngest child. In spring the grass has but little nitrogen left to pass on ; so the roots get to work early to obtain fresh supplies from the soil ; but nitrogen is not readily forthcoming from the soil ; warmth alone can release it. In time, a belated flush of grass appears, but the nitrogen stored by the root is soon used up, and the grass dies down ; another wait. The roots accumulate more nitrogen, and late in summer a second flush appears ; but it soon dies away. Like Charles Lamb, the grass makes up for coming late by going early. On these half-starved pastures the grazing season is short and intermittent. Is it not likely that the privations endured by the flocks and herds feeding on such pastures have their effect upon mankind ?

The poverty of the earth starves mind as well as body ; it infects philosophy with pessimism, and burdens the songs of poets with sadness. An earth bountifully supplied with healthy vigorous life would sing the happy songs that Blake wanted men to sing, and hope would again arise in a world desperately in need of it.

Newton found out that apples fall by gravity : it has only recently been learned that it is nitrogen-hunger that gives gravity its chance. Apple-trees will bear a good crop annually if they are adequately manured. Sometimes apple-trees planted in a light soil remain unfruitful in spite of adequate dressings of nitrogen ; they are starved of potash, and annual or half-yearly doses will restore them in a year or two. Mineral deficiencies appear to play an equally important, and often decisive, part in inducing disease in both plants and animals. All plants need iron : beans and their like will not grow without boron ; tea in Nyasaland has suffered from lack of sulphur ; tomatoes in the Philippines have to be given homœopathic doses of copper ; some plants cannot thrive without zinc ; buckwheat cuts off the heads of its flowers if there is no chlorine in the soil. Potash serves the green plant as a partial substitute for sunshine ; magnesium is essential for the formation of chlorophyll ; and manganese acts as a stimulant to some plants. Among animals, calcium, iodine, fluorine, iron, and almost certainly manganese, copper and silicon, and possibly magnesium, are needed either for building purposes, or for promoting healthy growth and helping the body to resist disease.

The scarcity of essential plant-foods is all but

universal, and those who are obsessed with the idea of over-production may rejoice in this fact. But the abundance is largely one of half-starved plants and of periodically ill-nourished animals. If food is lacking in quality, its consumer will remain ill-nourished however much he eats. In the days when men lived by calories alone, or thought they did, energy-intake alone mattered; if a man got ill, the cause was ascribed to bad heredity or maleficent microbes. Now we know that starch, sugar, fats and proteins alone will not make us grow or thrive. How this comes about is well shown by the oat shoot. When the extreme tip—not more than 1 mm.—is cut off from the young green shoot, it ceases to grow. If the tip is replaced, the shoot grows again, and the same happens if, instead of the tip being replaced, a cube of agar or gelatin on which the tip has been kept takes its place. The explanation lies in the activity of a chemical messenger (growth-substance) present in the tip of the shoot. Such messengers control the growth of the green plant, and also that of animals. In the human body there are the special chemical messengers known as vitamins, which encourage growth, charm away disease and promote fertility. The green plant is the metropolis from which many of these vitamins set out on their journey to our world, and they reach us either directly in fruit or other fresh green foods, or indirectly in dairy produce and in meat.

To make the best of the world of the green plant, we must utilise to the full our knowledge of the vitamins and their mineral allies on one hand, and of the fertilising power of nitrogen on the other. In carotene, the precursor of vitamin A, summer grass is rich, and winter grass is poor. Summer grass, grown with nitrogen, dried quickly and kept out of contact with air, forms an ideal food, rich in carotene, for cows in winter, and the milk and butter they yield is a perfect food for children. Other and possibly greater benefits will follow from the use, as winter fodder, of lucerne, clover and other crops with all their summer vigour in them.

Through vast periods of time, a long winter of scarcity has alternated with a brief summer of abundance; hence primitive man made the waxing and waning of the sun, and of the earth's fertility, the basis of his mythology; even to-day we celebrate the awakening of life in spring with the Maypole dance.

The nitrogen and mineral scarcities of the earth have directed the evolution of the green plant; may they not also have helped to direct the evolution of mankind? Must not the recurrent malnutrition from which man perforce suffers leave scars upon his body and his mind?

Heredity teaches that our bodily and mental characters are determined irrevocably at birth; the masters of our fate are the genes that reside in the chromosomes of the cell-nucleus. Is it not possible that malnutrition may have undermined the resistance of the chromosomes themselves and weakened the power of the genes? In a world of nitrogen-plenty, the chromosomes might be well nourished, and infertile genes might get the tonic they need to make them fruitful. If that is so, the determinacy in our present view of heredity will disappear, and the age of the creative evolution of mankind will be at hand.

Obituary

PROF. GEORGES DREYER, C.B.E., F.R.S.

GEORGES DREYER was born on July 4, 1873, at Shanghai, where his father, Capt. G. H. N. Dreyer of the Danish Royal Navy, was stationed at the time. He was educated in Copenhagen, where he qualified in medicine in 1898 after a very brilliant career as a student. While serving as a medical officer in the Navy, he found time to do some work with Salomonsen in the Pathological Department of the University, and continued this later when he was house physician at the fever hospital. For a time he was responsible for the production of diphtheria antitoxin at the newly established Serum Institute, and he received his M.D. degree in 1900 for a thesis on diphtheria toxin and antitoxin. Dreyer became a *Privatdocent* in the University of Copenhagen, and carried on an astounding amount of research on a wide variety of subjects—typhoid agglutination, the effect of light on bacteria and protozoa, the action of enzymes, and other subjects. An interest in mathematics had been early stimulated by his father, and in all his varied research he attempted to obtain accurate quantitative results. He found existing methods unsatisfactory for exact quantitative work, and developed new technique in many branches of biological research. He travelled extensively in Scandinavia, Germany, France and England, and came into contact with the leading workers in many fields. An excellent linguist, he spoke Danish, French, German and English fluently.

In 1907, at the early age of thirty-four years, Dreyer was appointed to the professorship of pathology at Oxford. He was the first holder of the chair, although pathology had been taught at Oxford for some years and a new laboratory had been recently built. From 1907 until 1914 he organised and built up the department, and together with his colleagues carried out a considerable amount of research, particularly on the blood volume of mammals—probably one of his most important contributions to science. In 1914 he volunteered for service, and spent much time in France. His great experience of the

laboratory diagnosis of enteric fever proved to be very valuable, and the agglutination technique which he had developed several years previously in Copenhagen was very extensively used. With his colleagues he was able to show that the vast majority of cases of enteric fever in inoculated troops was not typhoid, but paratyphoid fever. He promptly pressed for the 'triple inoculation' instead of the single antityphoid inoculation of all troops. When, in spite of vigorous opposition, he was able to bring about this reform, he felt that his most important work with the R.A.M.C. was accomplished. He had become interested in the medical problems of flying, and he transferred to the Air Force. He designed an ingenious apparatus for automatically controlling the supply of oxygen to pilots, according to the altitude.

Dreyer returned to Oxford after the War, and carried out research on the assessment of physical fitness by vital capacity measurement correlated with certain body measurements; the serum diagnosis of syphilis; immunity to tuberculosis; effect of light on bacteria; bacteriophage, and other subjects. A generous grant from the trustees of the late Sir William Dunn enabled him to build a new laboratory which was completed in 1926. His capacity for administration, and his genius for taking a wide view of science was recognised by his election to the Hebdomadal Council and to the University Chest. He was for some years a member of the Medical Research Council, and served on several of its subcommittees.

Dreyer had been elected a fellow of the Royal Danish Academy of Science and Letters before he came to Oxford. He was also Officier de l'Instruction Publique, and for his military service he was created C.B.E. He was elected a fellow of the Royal Society in 1921.

Dreyer was a man of sound common sense, and his views on administration and on business matters were highly valued in the University, and in his own college, Lincoln, of which he had been a fellow since 1907. His great personal charm and his genial nature endeared him to his colleagues and he was a very welcome guest in common rooms and dining clubs in Oxford. He never suffered fools gladly, but he never bore malice against anyone. His lovable nature, great generosity and the power of inspiring his younger colleagues make the loss occasioned by his death on August 17 last the more deeply felt. He married in 1900 Margrethe Jörgensen, and had an ideally happy married life.

WE regret to announce the following deaths:

Mr. G. H. Bosch, who provided endowments for chairs of embryology and histology, medicine, surgery and bacteriology in the University of Sydney, aged seventy-three years.

Dr. Willard J. Fisher, research associate and lecturer in astronomy at the Harvard College Observatory, known for his studies of meteors, on September 2, aged sixty-six years.

Prof. D. A. Murray, emeritus professor of mathematics in McGill University, an authority on differential equations, aged seventy-three years.

Prof. F. L. Stevens, professor of plant pathology in the University of Illinois, author of works on fungal diseases of plants, who studied especially tropical parasitic fungi, on August 18, aged sixty-three years.

News and Views

Nobel Prize for Medicine and Physiology for 1934

IT is announced that the 1934 Nobel Prize for Medicine and Physiology has been awarded jointly to Dr. George F. Minot and Dr. William T. Murphy, of Boston, Massachusetts, and Dr. George H. Whipple, of Rochester, New York State, for their research into liver therapeutics in connexion with anæmia (*Times*, Oct. 26). Dr. Minot is professor of medicine at Harvard University and Dr. Whipple is dean and professor of pathology of the University of Rochester, New York. The liver treatment of pernicious or Addisonian anæmia, which is now the standard treatment for the disease, was developed by Minot and Murphy about eight years ago from the experimental work of Whipple and his associates on secondary anæmia in dogs. Whipple maintained his animals in an anæmic condition by frequent withdrawals of blood, and tested the power of different foodstuffs to cause blood regeneration by adding definite amounts to a standard diet on which regeneration did not occur. Among the substances so tested was liver. Minot and Murphy tried it in pernicious anæmia and found that adequate amounts produced a remission which is maintained provided the treatment is continued. Liver has little or no action in human secondary anæmias, but is effective in certain other anæmias which, like pernicious anæmia, are characterised by an increase in the amount of hæmoglobin in each red blood cell although the total amount per unit volume of blood is diminished.

LATER work has shown that the factor in liver which has proved so valuable in the treatment of pernicious anæmia can be obtained in extracts of much less bulk; it also appears to be produced by the action of normal gastric juice upon flesh foods. The deficiency in pernicious anæmia is a deficiency in the secretion of the stomach. The immediate and characteristic response to liver is an increase in the number of young red cells, or reticulocytes, in the blood; this is followed by an increase in the number of mature cells and in the percentage of hæmoglobin. Pernicious anæmia is a disease which was invariably fatal before liver treatment was adopted, although its course might show a series of remissions and relapses. With adequate liver treatment, patients may live indefinitely in normal health; and the

onset of the nervous disease which frequently complicates the later stages of pernicious anæmia is prevented. Liver, in fact, has played in the treatment of this disease a similar part to that of insulin in the treatment of diabetes.

Johann Carl Friedrich Zöllner (1834–82)

ON November 8, the centenary occurs of the birth of Johann Carl Friedrich Zöllner, who in the course of a comparatively short career raised himself to a distinguished position among German astronomers as a pioneer in astrophysics. He was born at Berlin, and passed through the Universities of Leipzig and Berlin with distinction; after holding office as an extraordinary professor, he was appointed in 1872 to the chair of physical astronomy at Leipzig. That same year he was elected an associate of the Royal Astronomical Society. In 1865 he had turned his attention to the larger planets, and he afterwards advanced a theory of their constitution which met with wide acceptance, directed attention to the rapid changes in the cloud-belts of Jupiter and Saturn, and made observations of the rotation of the planet. On February 6, 1869, before Janssen and Lockyer devised their method of observing solar prominences in broad daylight, Zöllner read a paper before the Saxon Society of Sciences on a method of doing this, but did not obtain a suitable instrument until some months later. In some of his work, Zöllner was assisted by his pupil Hermann Carl Vogel (1842–1907), afterwards director of the astrophysical observatory at Potsdam. Zöllner died on April 25, 1882, at the age of forty-seven years.

Legislative Control of British Fisheries

IN its report on the herring industry, the Sea-Fish Commission made far-reaching and drastic proposals for the re-organisation of the industry to meet the altered conditions of marketing, and thus to prevent a ruinous decline. The main recommendation was that a Herring Board should be appointed with very wide powers of control over the whole industry. The members of this Board should be nominated by the appropriate Ministers, and should number not more than eight, of which three, including the chairman, should be independent of the trade. Before asking the Government or the Treasury to consider any of the Commission's proposals, however, the Secretary of State for Scotland and the Minister of Agriculture and Fisheries desired to ascertain the views of the fishermen and of the other interests concerned. Accordingly, they arranged to meet a representative conference of all branches of the industry, and this meeting took place at the Scottish Office on October 25. It is learned that, subject to certain reservations made on behalf of Clyde fishermen and exporting interests, the recommendations of the Commission met with the unanimous approval of the industry. If (as now seems likely) the Government decides to go forward with the Commission's proposals, the subjection of the British fisheries to legislative control will be complete. With local by-laws controlling fishing within territorial waters, orders-in-council governing the trawl fisheries of the high seas and the Herring Board directing the herring fisheries, administrative machinery will have superseded individual freedom in fishing and marketing. This greatest of all experiments in the modern history of British fishing is all the more remarkable because it has the general approval of the industry itself. It will surely command the closest attention and interest of economists and biologists alike.

Electrical Properties of Insulating Materials

PROF. W. M. THORNTON, of Armstrong College, Newcastle-on-Tyne, took as the subject of his inaugural address, given to the Institution of Electrical Engineers on October 25, the electrical properties of insulating materials. He said that there is much in the advanced electrical science of to-day that can never come into practice, yet in the maze of experimental research and wave mechanics which constitute modern physics, there is hidden the explanation of some of the outstanding problems of electrical engineering. Industry is impatient and has to advance without waiting for the slow formulation of fundamental theory. As a result, the insulation engineer in the past found himself responsible for vast expenditures, with little but empirically gained experience for his guidance. In these circumstances, it is not surprising to find that in many respects it is the problem of electrical insulation that is holding back the fullest development of high-voltage engineering for the transmission of large blocks of electrical power. There is at the present time no theory of dielectric behaviour that covers all the facts. Yet there seems to be behind the phenomena a hidden simplicity at least as simple as the free-electron theory of conductors. For example, it has been shown experimentally that the electric strength of air is in fact a physical constant comparable in accuracy of determination with most of the constants of Nature. We know also that all insulators break down at a lower voltage when the frequency of the field is raised. Prof. Thornton showed some beautiful experiments to illustrate that dielectrics obey simple laws. The nineteenth century was the age of the machine. Perhaps the twentieth century will be regarded as the age when insulation was made perfect.

Australian Wool and Capt. John Macarthur

IN the course of his Australian tour, the Duke of Gloucester visited the Ercildoune shearing sheds, where he sheared a sheep which is reported to be a direct descendant of the original merinos introduced into New South Wales by Capt. John Macarthur (*Times*, Oct. 30). Capt. Macarthur was born at Plymouth in 1767, and was educated at a local school. Becoming a lieutenant in the 102nd Foot, or New South Wales corps, raised for service in the colony, he retired with a captaincy in 1804. Macarthur possessed an extensive grant of land at Paramatta, and as one aspect of his agricultural pursuits, engaged in improving the breed of sheep in the colony; the "Dictionary of National Biography" says of him that he "practically created the trade in

Australian wool". Sir Joseph Banks, then president of the Royal Society, was also interested in the introduction of breeds of sheep into Australia, and received fleeces from Macarthur which were reported upon by H. Laycock. Banks, in fact, had many dealings with Capt. Macarthur concerning sheep and wool and also grants of land, some leading to acrimonious letters and mutual distrust. These may well be viewed by posterity with lenient tolerance, as being perhaps inevitable on both sides with the masterful types of men who were then involved in discussions affecting methods of colonisation. Macarthur died in 1834.

Photochemical Reactions

AN admirable account of the history and present position of photochemistry was given by Prof. A. J. Allmand, of King's College, London, in delivering the twenty-seventh Bedson Lecture at Armstrong College, Newcastle-upon-Tyne, on October 27. Tracing it from the work of Cruikshank and Scheele to that of Planck, Einstein and Warburg, he gave a concise account of the interpretation of absorption spectra, and the conception of activation, along with the application of kinetics to photochemical reactions, with consideration also of sensitised reactions. He related that the German chemical warfare records mentioned the difficulty experienced in the complete chlorination of methyl formate, in which the yield obtained varies apparently capriciously from eighty to about two per cent. This was actually due, as Luther had shown for the homologues of benzene, to the absence or presence of air, oxygen being a powerful inhibitor. Further, it has been shown that under various conditions reaction tends to vary as the square root of light intensity, instead of being directly proportional to it, and in the case of the decomposition of hydrogen peroxide a maximum is reached in the plot of concentration against rate. In the combination of hydrogen with chlorine, intensive drying does not in fact inhibit the reaction. In the sensitisation of the decomposition of ozone by chlorine, there is formation of the oxide Cl_2O_6. In the bromination of benzene in the light, the red or brown liquid residues were found to contain $C_6H_6Br_2$, and possibly $C_6H_6Br_4$. Summarising, Prof. Allmand said that photochemical reactions tend to be complex, consisting of consecutive interactions of the free groups or atoms which are the primary products.

A Fast American Stream-line Train

IN France, the United States, Germany, Italy and Great Britain, experiments are being made with train units driven at high speed by internal combustion engines. The carriages are constructed of either stainless steel or aluminium, all weights are reduced to a minimum and the trains are stream-lined to lessen so far as possible the resistance due to the air. Oil or petrol engines are used, generally with electric transmission. Several of these train units have been described in our contemporaries, the *Engineer* and *Engineering*, and the *Times* of October 26 recorded a very fast passage made across the United States by a stream-line train belonging to the Union Pacific Railroad. This train, named *M 10001*, which it is stated is driven by a 900 h.p. Diesel engine, arrived at the Grand Central Terminal, New York, at 9.55 o'clock on October 25, after crossing from Los Angeles in 56 hours 55 minutes, beating every existing record in America. During the passage of the 508 miles between Cheyenne and Omaha, the train had an average speed of 84 miles an hour, while over short distances it ran at 120 miles an hour. The train with two others, larger and more powerful, which are being built, will be put in regular service between Chicago and California.

Centenary of Lloyd's Register

THE world-famous society, Lloyd's Register of Shipping, celebrated on October 25 the centenary of its reconstitution by a dinner at the Savoy Hotel, which was attended by about four hundred distinguished guests, members of the staff and representatives of various shipping and commercial interests. The society has been described as a voluntary association of underwriters, shipowners, shipbuilders and others existing for the purpose of surveying and classifying the shipping of the world. It provides a means of self-government for shipping, and is neither State-aided nor a profit-making concern. Of British shipping, more than three quarters is at present classed with Lloyd's Register, and of the ships being built throughout the world, 74 per cent are being constructed under the society's supervision. Its surveyors are found in every important seaport in the world, and in paying a tribute to its work, Mr. Runciman, the president of the Board of Trade, said that for many years Lloyd's Register has classified more ships than all the other classification societies in the world, and it has done so on an international basis which has given uniformity to the trade it has served so well. It has standardised the basis of material and design, and has made a contribution to the safety of travel which could not have been made by any other means. The society is shortly publishing a centenary edition of the "Annals of Lloyd's Register", which will contain a wealth of information anent the development of merchant shipbuilding from the days of the wooden ship to the launch of the *Queen Mary*.

Texture and Chemical Resistance of Materials

DR. C. H. DESCH delivered a public lecture on October 26 before the Institution of Chemical Engineers on "Texture and Chemical Resistance". Dr. Desch pointed out that the resistance of materials of construction to attack by chemical agents depends not only on their composition, both ultimate and proximate, but also on their texture. This is illustrated by the differences between the behaviour of wrought iron and mild steel, the attack of sulphates on limestone, and the action of hard and soft waters on concrete dams. On a finer scale, the resistance of metals and alloys to chemical attack is affected by the grain size, the presence of cold-worked regions, the smoothness of the surface, and the directional effects of rolling and drawing. In steels, the distribu-

tion of the carbides and the size of their particles influence the rate of attack by acids. The texture of the resisting or 'stainless' steels to steam at high temperatures depends on the distribution of the compounds precipitated from the solid during heating. Oxidising agents produce a thin skin on the surface of many metals, and this protects against further action, or fails to protect, according to the texture of the oxide so formed. On a yet finer scale, certain classes of solids containing 'giant molecules' have their chemical properties determined by the shape of those molecules, whether forming thin sheets, fibres, or a loose network. Examples are graphite and other forms of carbon, textile fibres and the zeolites. The study of texture, usually by means of the microscope but also making use of many physical methods, is therefore an essential part of the study of chemically resistant materials.

The Future of Governments

An address delivered by N. M. Butler at the Parrish Art Museum, Southampton, Long Island, on September 2, attributes the attack on 'liberalism' in the world generally to the very limited extent to which knowledge and power have been linked in official public life, compared with industrial and commercial life. The wide gap between instructed public opinion and Government, and the control of Government by legal formulæ, by passion and by highly organised and effective self-seeking minorities, are largely responsible for the deadlock which threatens many fields of public action. Mr. Butler does not believe that compulsion, whether by a dictator or by a majority, offers any permanent solution of our difficulties. What is required is intellectual and moral discipline to fit mankind for the use of liberty. Dictatorships, no less than democracies, have failed to readjust their policies or the economic life of the peoples concerned to the revolutionary changes in production and intercourse brought about by the application of science. The highest task of liberalism to-day, he claims, is to meet this situation, to show how to end this international anarchy and confusion and to solve these new problems constructively without resort to any form of compulsion. Mr. Butler outlined very broadly the principles of a programme ensuring not only freedom of thought, speech, worship and assembly but also of opportunity to earn a livelihood, and insisted on the importance of preserving individuality in the economic as in other spheres. The whole area of civilisation requires widening and integrating to relieve the economic conditions from which the attack on liberalism largely arose, and Government, agriculture, industry, transport, commerce and finance require adjusting to the conditions of human life and action existing to-day.

Industry in New Zealand

Discussing the prospects of industry in New Zealand in an address to the Dunedin Chamber of Commerce on August 21, Lord Bledisloe said that the decline in international commodity exchange and the growing tendency towards economic self-sufficiency must inevitably cause anxiety in countries like New Zealand, Denmark or Argentina, the economic existence of which is conditional upon the export of agricultural produce. New Zealand will have to search for new directions in which her industrial activities may expand, though this as yet can scarcely be in the direction of large-scale industrial production owing to her small population and limited consumptive capacity. First and foremost, efforts should be made to develop the 'tourist industry', which presents great possibilities provided the travel, hotel and similar interests organise and co-ordinate their efforts. Timber plantations, especially of the native beech, should prove a valuable asset, since conditions elsewhere foreshadow a world-wide timber famine within the next half-century. If properly managed and protected from insect and fungoid pests, the forests should afford remunerative employment to a large section of the rural population. Of New Zealand's mineral resources, gold is the most important and indeed seems likely to open up the most promising avenue for providing fresh employment. Yet another development of importance would be the revival of the once profitable kauri-gum industry now made possible by new methods of refining low-grade gum. The extraction of oil from the local 'groper' presents distinct possibilities since it is 100 times richer in vitamin A than the average cod liver oil. Important new industries might be inaugurated for canning meat and for manufacturing casein from surplus milk; the former could readily be marketed in Britain since there is no quota for canned meat as there is for chilled meat.

Preservation of Natural Woodland

Mr. W. Dallimore read a paper on amenity planting and the preservation of natural woodlands before Section K at the recent meeting of the British Association at Aberdeen. "Amenity planting," Mr. Dallimore said, "and the preservation of natural woodland may be regarded as common ground whereon arboriculture and sylviculture meet." This somewhat dangerous statement is qualified by the subsequent remark that "In many respects sylviculturists are better placed for general amenity supervision than men who are engaged upon arboriculture". Until comparatively recently, the true work of the sylviculturist was but little understood in Great Britain. In fact, by many it was considered to cover all aspects of the forester's work save that of exploitation and extraction. A truer understanding now exists, and Mr. Dallimore is correct in saying that the sylviculturist generally is in a better position to undertake or supervise general amenity work in woodlands and so forth: though this does not mean that he is always as capable as the arboriculturist specialist. The day has arrived, however, in Great Britain when a sharp division should be made in estates budgets, both Government and privately owned, between all planting done for purely amenity purposes, and plantings undertaken for commercial forestry production. Forestry is a definite business

concern, and if a profit is to be made, it should not have to carry expenditure incurred for work undertaken to beautify a locality; an object quite apart from the utilisation of the soil as a commercial asset. Mr. Dallimore dealt with the various types of planting for amenity purposes, such as garden and park trees, field and hedgerow trees, road-side trees, small shelter plantations and woods of varying type open to the public as pleasure resorts.

Weather in Great Britain and Ireland in 1933

THE most recently published annual volume of the *Weekly Weather Report* (The Weekly Weather Report for the Period February 26, 1933 to March 3, 1934. M.O. 374. London: H.M. Stationery Office. 7*s*. 6*d*., postage extra) is the fifty-sixth that has appeared since the publication of meteorological data in weeks by the Meteorological Office was first begun, and is the fifth in which the data are largely presented in the form of deviations from normal values of the different elements. The deviations of temperature are given in whole degrees, of accumulated temperature (reckoned from 42° F., the zero of temperature from the point of view of plant growth) in day degrees, while for rainfall and sunshine the percentage of the normal for the appropriate week or season is quoted. This report is designed to be used for correlation with agricultural data, for which as a time unit the day is regarded as being too short, and the month too long. The year begins and ends, as in former volumes, with early spring, the whole period under review in this case beginning on February 26, 1933, and ending on March 3, 1934, and the tables are based on the records of fifty-seven stations well distributed throughout Great Britain and Ireland. The time of commencement was for England within a wet period following a remarkably dry winter, which came at a favourable time for agriculture in so far as it supplied the land with some reserves of water, and enabled many crops to withstand the drought, heat and abnormal sunshine of the summer and autumn of 1933 far better than they would have done had the winter drought not had this pronounced check. The period as a whole was with few exceptions one with excess of sunshine over England, especially in the south-east and the Midlands. There was general dryness and warmth throughout the British Isles, the warmth being especially pronounced in spring and summer; July and August provided more than one spell of tropical heat, without however quite repeating the very exceptional extremes of the August of the preceding year.

Recent Acquisitions at the Natural History Museum

AMONG the recent acquisitions of the Department of Zoology is a collection of 300 birds obtained by Mr. A. W. Vincent in the south-eastern district of the Belgian Congo. This is an area which has been very little investigated from the ornithological point of view. A valuable recent addition to the collection of Hemiptera (bugs) in the Department of Entomology consists of a collection of 17 specimens of Termitaphidæ presented by Dr. J. G. Myers of the Imperial College of Tropical Agriculture, Trinidad. These rare and little-known insects are found only in the nests of white ants in America and in the Old World, but the nature of this association is not known. A purchase of particular interest is a collection of 500 beetles from Tibet, Central Asia, western China and the Altai Mountains; the majority of the specimens were described by Continental authors and are paratypes of species hitherto unrepresented in the Department. The Public Schools Exploration Society has presented the whole of the entomological collections made during its recent expedition in Newfoundland. The Department of Geology has acquired a collection of primitive fish-like Ostracoderms comprising a hundred specimens obtained by Mr. Wickham King, chiefly from the Old Red Sandstone of Worcestershire; and a fine series collected by Dr. E. I. White and Mr. H. A. Toombs from Herefordshire, comprising many forms new to science, of which the most interesting are specimens of *Pteraspis*, which show for the first time the unusual form of the tail. A valuable collection of gemstones has been bequeathed to the Department of Minerals by the late Mr. T. B. Clarke-Thornhill, including ninety cut stones, many of them of large size, of various minerals—a fine series of sixteen coloured diamonds, parti-coloured corundum, tourmaline, opal, alexandrite, phenakite, etc.; also uncut specimens of opal, moonstone, and large masses of Kauri-gum from New Zealand. The first meteorite to be recorded from Rhodesia, a stone weighing 48 lb. 11 oz. which fell on March 7, 1934, in the Mangwendi native reserve, 40 miles east of Salisbury, has been presented by the Government of Southern Rhodesia.

Proposed Museum at Verulamium

THE City Council of St. Albans is preparing plans and proposes to seek powers for raising £15,000 for the erection of a museum on the site of the Romano-British city of Verulamium. The museum will be devoted to housing the valuable collection of antiquities found on the site during its recent excavation by Dr. and Mrs. Mortimer Wheeler. The proposal of the Council is a fitting sequel to its enlightened action whereby the excavation, which has proved so fruitful in results, was made possible. Not only has the importance of Verulamium as a centre of Romano-British life and culture been fully confirmed by increased knowledge, but also it is now possible to appreciate more justly the significance and influence of this centre in relation to the rest of the peoples of pre-Roman Britain. The value of the collections to the student will be vastly enhanced by the opportunity the building will afford for the proper display of these antiquities without the distraction of other exhibits by their side; while the effect of such a display as a unitary collection in the midst of its native setting will be to enhance both its historical and its cultural value. The Council is wisely consulting Dr. Mortimer Wheeler before deciding on the exact site of the museum in order to avoid the possibility of interference with any future exploration.

Sanitation of Rural Ar:as in the Tropics

IN a Chadwick public lecture, delivered on October 25, on the sanitation of rural areas in the tropics and sub-tropics with special reference to housing, Prof. D. B. Blacklock expressed the view that rural sanitation in tropical and sub-tropical dependencies and possessions is gravely neglected. He touched on the subject of hygienic conditions in rural West Africa, but attention was directed chiefly to the present state of rural India. The chief part of the lecture dealt with housing in the rural areas, and Prof. Blacklock emphasised by suitable illustrations how diseases of various kinds come to be associated with types of houses showing special defects. These defects are either of site, of structure and material, or dueto the habits of the inmates. A house-relation of many diseases in tropical and sub-tropical countries is directly traceable to an origin in such defects ; the removal of the known defects would largely eliminate those house-diseases, which seriously affect millions of people. To-day we have at our disposal in the shape of broadcasting a valuable method of imparting the principles of village hygiene even to those who can neither read nor write. In addition to such educative methods, it is the duty of any Government which wishes to attain success in raising the standard of rural sanitation to undertake a further measure. This is the building, using local materials so far as is possible, of standard houses and villages at many accessible places in each province or even district as examples of hygienic construction. Demonstration villages kept up to the standard would exemplify to the villagers more vividly than other methods the dangerous defects of their own homes.

Pathology at Leeds

THE Department of Pathology and Bacteriology, University of Leeds, has issued its annual report for 1933 by Profs. Stewart and McLeod, with some details of the research work in progress. This includes investigations on industrial lung diseases, namely, pulmonary fibrosis of hæmatite miners and asbestos workers, correlation of types of diphtheria bacilli with clinical severity of the cases, phenomena of bacterial respiration, bacterial hæmolysins, and industrial problems such as the bacterial purification of gas-works' effluents. A brief report by Prof. Passey on cancer research is also included.

New British Birds

THE note under this heading in our "News and Views", October 27, p. 658, was prepared before the error in the original announcement by the British Ornithologists' Union became known. The Continental song thrush, renamed *Turdus ericetorum planiceps* in the July issue of *Ibis*, should now read *Turdus ericetorum philomelus* (*Ibis*, October).

Marmite: Vitamin B_1 Content

WITH reference to the recent statement in our columns (NATURE, Oct. 20, p. 623) that the yeast extract "Marmite" contains 840 international vitamin B_1 units per oz., Mr. A. R. Keast, 4 Anne Boleyn's Walk, Cheam, Surrey, writes that in answer to inquiries made some months ago, he was informed that this result had been obtained from an isolated sample furnished by the Marmite Food Extract Co. Ltd. Biological assays of ordinary Marmite carried out in Mr. Keast's own laboratories and elsewhere have never, apparently, yielded a result higher than 280 international units per oz. This figure, although high, is lower than the assayed content of certain other products on the market.

Announcements

DR. HERBERT DINGLE, assistant professor of astrophysics in the Imperial College of Science and Technology, will deliver the Cantor Lectures of the Royal Society of Arts on November 19, 26 and December 3. His subject will be "Modern Spectroscopy".

THE Onyx Oil and Chemical Co., 15 Exchange Place, Jersey City, N. J., has founded an industrial fellowship in the Mellon Institute of Industrial Research, Pittsburgh, Pa., to be held by Dr. Robert N. Wenzel, who is working on problems in textile processing and finishing. Dr. Wenzel is well known for his studies of fatty acids and related compounds.

IN connexion with the centenary celebrations at Melbourne, a temporary exhibition of drawings and maps commemorating Admiral Phillip, the first Governor of Australia, has been placed in a case in the Central Hall of the Natural History Museum. The thirteen sketches by Thomas Watling, a convict transported in 1792 for forgery, and other contemporary artists, show Sydney and Port Jackson as they were at the close of the eighteenth century, the arrival of the Governor in H.M.S. *Sirius*, aborigines, and the earliest known illustration of the Echidna. The maps of Norfolk Island and Port Jackson are of considerable interest. It was on Norfolk Island that Capt. James Cook, the discoverer of Australia, landed in 1774.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in electrical engineering at Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham (Nov. 8). An assistant at the London Museum—The Keeper, London Museum, St. James's, S.W.1 (Nov. 17). A dean of the British Postgraduate Medical School—The Chairman of the Governing Body, British Postgraduate Medical School, New Public Office, Whitehall, London, S.W.1 (Nov. 17). An experimental officer for wireless research work in the War Department Establishment at Chatham—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Nov. 19). A Hackett professor of agriculture in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, London, W.C.2 (Nov. 20). An understudy to the Deputy Director of Research of the British Cotton Industry Research Association—The Director of Research, Shirley Institute, Didsbury, Manchester.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Situation of the A ($^3\Sigma$) Level in the Nitrogen Molecule

IN a recent communication in NATURE, Appleyard, Thompson and Williams[1] have discussed the question as to the height of the A level of the nitrogen molecule, which is the bottom state of the first positive group.

Using the electron collision method, they find for the excitation potential of the first positive group the value 8·34 volts, in good agreement with previous measurements of Sponer. This result they take to indicate that the height of the A level or the level difference (X-A) should be considerably higher than the value derived from the bands recently observed by Kaplan. They express the opinion that the bands observed by Kaplan are too limited in number for a determination of the vibrational terms with such an accuracy as to prove their identity with the vibrational terms of the A and X level.

If the interpretation of the Kaplan bands and the calculation of vibrational terms were merely based on the few bands observed by him, Appleyard, Thompson and Williams would be justified in expressing some doubt as to the validity of his interpretation; but in this connexion I wish to direct attention to the fact that the Kaplan bands—as clearly pointed out by Kaplan himself—are identical with the bands of the so-called ε-system, which I discovered nine years ago in the luminescence from solid nitrogen.

This ε-system appears with great intensity and up to the present no less than 111 vibrational bands belonging to this system have been observed. In the lower level of the ε-system, 22 vibrational states have been measured, and in the upper electronic level 7 vibrational states are concerned in the formation of the observed bands.

In a paper published in 1930[2] it was shown that the bottom level of the ε-system was identical with the normal state of the nitrogen molecule, which forms the bottom level of the Lyman and the Birge-Hopfield bands. As a consequence, an electronic level of the N_2-molecule had to be placed about 6 volts above the normal state. In a paper published in January 1932[3], I showed that this upper ε-level was no doubt identical with the bottom level (A) of the first positive group, and this would have the effect of lowering the A level about 2 volts from the height then accepted.

During the past year, Mr. S. Stensholt and I have obtained spectrograms of the ε-bands in the region from red to far in the ultra-violet with a 1-metre grating spectrograph giving dispersion of 17 A./mm. and a corresponding accuracy of the wave-length measurements (probable error about 0·02 A.).

A more complete account of our results relating to the ε-system will be given in a subsequent paper. In this connexion I merely wish to mention that on the basis of the new measurements, we have found the following more accurate and slightly modified formula for the ε-band system:

$$=49617{\cdot}5+(1444{\cdot}6v_1-13{\cdot}7v_1^2)-(2344{\cdot}2v_2-14{\cdot}6v_2^2).$$

The vibrational term of the A level derived from the first positive group is:

$$1446{\cdot}46v-13{\cdot}93v^2,$$

and the vibrational term of the normal (X) state derived from the Lyman and the Birge-Hopfield bands is:

$$2345{\cdot}16v-14{\cdot}445v^2.$$

Within the limit of error, these terms are seen to be identical with those of the upper and lower level of the ε-system respectively.

From the formula of the ε-system, we find that the difference in height between the vibrational zero levels corresponds to 6·12 volts, or the electronic levels corrected for vibrational influence should be situated 6·18 volts apart. In other words, the electric (A) level forming the bottom level of the first positive group is situated 6·18 volts above the normal state (X).

This result is in good agreement with the results of Smyth, Levesly, Rudberg and Brindley, who by electron bombardment found signs of an electronic state between 6 and 7 volts. In view of the results derived from the study of the ε-system, this level is no doubt identical with that of the upper ε-state, which again is identical with the A ($^3\Sigma$) state.

The excitation potential of 8·34 volts found by Appleyard, Thompson and Williams then must mean that for some reason a potential considerably higher than (A-X=6·18 volts) is necessary to excite the first positive group.

L. VEGARD.

Physical Institute,
University, Oslo.
Sept. 25.

[1] NATURE, **134**, 322, Sept. 1, 1934.
[2] *Ann. Phys.*, **6**, 487; 1930.
[3] *Z. Phys.*, **75**, 30; 1932. Compare also *Z. Phys.*, **79**, 471; 1932.

Isotope Effect in the Band Spectrum of Sodium Hydride

As has been pointed out by Holst and Hulthén[1], the elementary theory of isotopy in band spectra cannot account for shifts and the constants of deuterides, determined with the highest precision. They find it necessary, in calculating the reduced mass of the molecule, to add a correction for the electronic masses, which are supposed to partake fully in rotation and vibration. Since this correction is quite general, one would expect it in all deuterides determined with sufficient precision. The only reported cases which fulfil this prescription are:

AlH/AlD [2], calculated ratio of the reduced masses

$$=\frac{\mathrm{Al}\cdot\mathrm{H}}{\mathrm{Al}+\mathrm{H}}:\frac{\mathrm{Al}\cdot\mathrm{D}}{\mathrm{Al}+\mathrm{D}}=\rho^2=0{\cdot}51848,$$

$$\text{observed, } \rho^2=\frac{B_e\,(\mathrm{AlD})}{B_e\,(\mathrm{AlH})}=0{\cdot}51889.$$

CaH/CaD [3], calc. $\rho^2=0{\cdot}51276$, observed $\rho^2=0{\cdot}51337$, and from an investigation of NaD by the present author,

calc. $\rho^2=0{\cdot}52147$,
observed in the normal state, $\rho^2=0{\cdot}5222\pm0{\cdot}0003$.

In all these cases the agreement between calculated and observed values is complete, if one adds the small correction proposed by Holst and Hulthén.

It must be mentioned, however, that the constants α_e, ω_e, x_e, etc., cannot be calculated with the same accuracy, and therefore further additions to the theory of isotopy are required.

The rotational constants of the excited state in NaH and NaD cannot be used in calculating ρ^2, due to the known strong irregularities[4] in this state. It is hoped instead that the isotope effect may contribute to the explanation of these irregularities. A detailed report will appear later.

Laboratory of Physics, University, Stockholm. E. OLSSON.
Sept. 14.

[1] NATURE, 133, 796, May 26, 1934.
[2] Holst, W., and Hulthén, E., NATURE, 133, 496, March 31, 1934.
[3] Watson, W. W., *Phys. Rev.*, 46, 319; 1934.
[4] Hori, T., *Z. Phys.*, 71, 478; 1931.

Complexity of the Solid State

THE theory of allotropy assumes that every state of aggregation of a so-called single substance is complex, so that every crystalline state consists of mixed crystals, built up of molecules of different kinds. These different kinds of molecules can change the one into the other. The transformation can lead to a chemical equilibrium, and only when this equilibrium (inner equilibrium) is established does such a pure substance behave as a real single substance.

If this equilibrium is established slowly, or if the transformations are stopped, then a pure substance will behave as a mixture. Ten years ago[1] we studied the behaviour of sulphur trioxide after drying with freshly distilled pure phosphorus pentoxide[1]. Since sulphur trioxide itself possesses strong self-drying properties, after a short drying, it showed its complexity distinctly. Thus we were able to change greatly the vapour pressure of the high-melting asbestos form by partial evaporation, for example, at $\pm 36°$ from 200 mm. to 2·5 mm. of mercury.

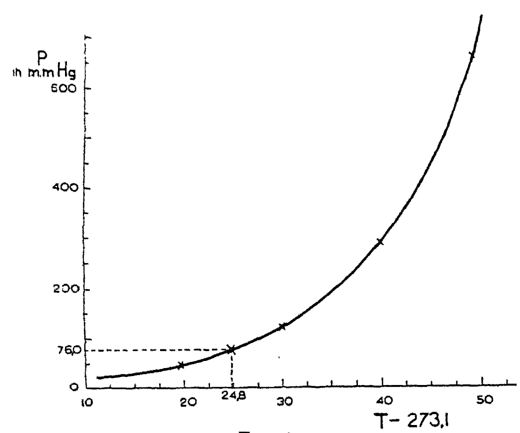

FIG. 1.

In measuring the vapour pressure in a bath at constant temperature, we found that the vapour pressure rose with decreasing velocity, approaching asymptotically after several weeks or months an end value. The curve answers closely to a hyperbola represented at 30° by the following equation:

$$\frac{1}{120 - p} = 0{\cdot}00710t + 0{\cdot}0140 \qquad (1)$$

or

$$p = \frac{680 + 852t}{7{\cdot}10t + 14{\cdot}0} \qquad (2)$$

Our equation shows that when $t = \infty$, $p = 120$, which means that when inner equilibrium is established, the vapour pressure at 30° will be 120 mm. mercury. In this way, the end vapour pressure of the initial disturbed high-melting asbestos form is determined at different temperatures so that the vapour pressure curve of this form in inner equilibrium can be plotted (Fig. 1).

In 1926, one of us discovered that irradiation by X-rays (copper rays) accelerates the establishment

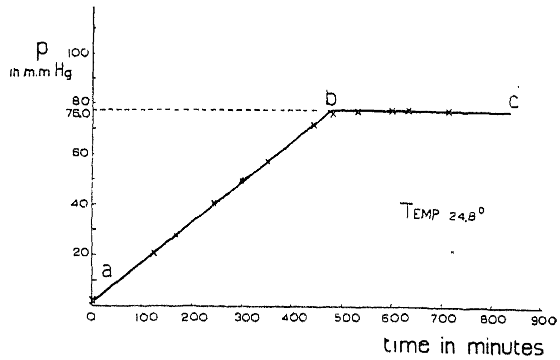

FIG. 2.

of the inner equilibrium in a high degree, so that within 8 hours the inner equilibrium was reached[2]. On continuing these researches, and measuring the increase of the vapour pressure of the irradiated disturbed substance, we obtained the remarkable result illustrated in Fig. 2, in which the pressure is plotted against the time of exposure to the X-rays. From this, it follows that after 598 minutes, increase of the vapour pressure ceases, that this value is 76·0 mm. mercury at 24·8°, which corresponds exactly to the vapour pressure in Fig. 1 at the same temperature. This proves that irradiation by X-rays greatly accelerates the establishment of the inner equilibrium.

Plotting the vapour pressure during irradiation against the time in minutes, we get a straight line, as shown in Fig. 2, *ab* ending at *b*, after which the vapour pressure remains constant, following the straight line *bc*, proving that at *b* inner equilibrium is reached. It may be added that examination of the irradiated substance showed that not the smallest trace of sulphur dioxide was formed.

The course taken by the vapour pressure on irradiation with X-rays is remarkable, since from it the conclusion can be drawn that the thermal reaction taking place in the disturbed substance is quite different from the reaction caused by X-rays. In the latter case, the reaction is of zero order, that is, independent of the pressure. What is the effect of X-rays here? The disturbed substance is probably very rich in a polymer of SO_3 and very poor in single molecules. Therefore it seems that X-rays are able to split up the polymerised molecules in the solid phase with the result that the vapour pressure increases. Density determinations showed that the vapour consisted almost entirely of single molecules. The remarkable thing here is that an X-ray quantum represents too large a quantity of energy per molecule for such a reaction as this. We must imagine therefore that one quantum is taken up either by a number of polymerised molecules, which is not very probable, or that a kind of photoelectric effect occurs.

The photon coming into collision with a polymerised molecule gives up a part of its energy, which is taken

up by the dissociating molecule. The explanation of this very remarkable phenomenon cannot be given with certainty until the results of further experiments are available[3].

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[1] NATURE, **113**, 855, June 14, 1924.
[2] *J. Chem. Soc.*, 1603; 1926.
[3] E Adinolfi (*Atti R. Accad. Lincei*, **8**, 381; 1928) found that the specific heat of bismuth is increased by about 14 per cent and that of tellurium by 8 per cent by exposure to X-rays. D. Coster and A. v. d. Ziel (*Z. physik. Chem.*, B, **20**, 283; 1933) found that irradiation with X-rays of the monoalkyl malonic acids accelerates strongly the transformations taking place in these substances.

Magnetron Oscillations of a New Type

IN a recent issue of NATURE[1] Dr. Megaw suggests that the magnetron oscillations dealt with in my letter[2] should be "dynatron oscillations" of the type described in his fundamental paper: "An Investigation of the Magnetron Short-Wave Oscillation"[3].

One condition that oscillations should be of a "dynatron" character is the presence of a static negative resistance. In our case such a negative resistance could not be measured. Also there was a definite lower frequency limit for every adjustment of anode tension and magnetic field as well as an upper frequency limit, both limits being fairly close together. This fact is not in favour of the "dynatron" theory.

In a paper which has not yet appeared, the generation of the oscillations is shown to be possible under the influence of the tangential alternating electric field, which can be resolved into two rotating fields. As one of these components plays the principal part, the oscillations are called "rotating field oscillations" in this paper.

For the upper frequency limit is derived the equation

$$\omega_{\text{max.}} = \tfrac{1}{2} H \frac{e}{m}\left[1 - \sqrt{\left(1 - 8\frac{V_a^2}{r^2H^2}\frac{m}{e}\right)}\right] \text{ or}$$

$$\omega_{\text{max.}} = \tfrac{1}{2} H \frac{e}{m}\left[1 - \sqrt{\left(1 - \frac{H^2_{\text{cr.}}}{H^2}\right)}\right].$$

$H_{\text{cr.}}$ is the critical cut-off field strength, the other symbols are the same as those used in my previous letter. As an approximation, this is transformed to $\omega_{\text{max.}} = 2\ V_a/r_a^2H$ in my previous letter, only holding for $H \gg H_{\text{cr.}}$, and for a four-plate magnetron the frequency should be twice this value.

Therefore these formulæ yield the upper frequency limit for *every* value of $H > H_{\text{cr.}}$, and it would not be clear what proof is to be derived for the identity of these oscillations and the "dynatron" oscillations, when for H is substituted the arbitrary value $H_{\text{cr.}}$, apart from the fact that the approximate equation $\omega_{\text{max.}} = 2\ V_a/r_a^2H$ is not valid for $H = H_{\text{cr.}}$.

The equations are confirmed by experiment. As already stated, there exists also a lower frequency limit, which is found experimentally to be equal to

$$\omega_{\text{min.}} = \tfrac{1}{4}\frac{e}{m} H\left[1 - \sqrt{\left(1 - \frac{4}{3}\frac{H^2_{\text{cr.}}}{H^2}\right)}\right],$$

this expression being obtained by drawing a straight line through a group of experimental points in a certain diagram.

For $H \gg H_{\text{cr.}}$ this can again be simplified to

$$\omega_{\text{min.}} = 4/3\ V_a/r_a^2H.$$

In the rotating field theory mentioned above, these limits have the following physical significance. When $\omega = \omega_{\text{max.}}$, the radial velocity of the electrons arriving on the anodes equals zero. When $\omega = \omega_{\text{min.}}$, the total kinetic energy of the electrons reaching the anodes equals one third of the energy corresponding to the D.C. potential. As formerly stated, this latter limit is found experimentally, and at present I see no reason why this figure should be precisely one third.

From the rotating field theory it is obvious that for four-plate magnetrons all frequencies are twice the values for two-plate magnetrons, which is very well confirmed by experiment. Recently we succeeded in obtaining weak oscillations from an eight-plate magnetron, the frequency being equal to four times the frequency obtained from a two-plate type under similar conditions. However, this was only possible for values of H not much greater than $H_{\text{cr.}}$; for higher values of H the electrons are confined to an area where the tangential rotating field cannot become appreciable.

As stated in my previous letter, the output obtainable at about 40 cm. is of the order of 30 watts for a four-plate magnetron, whereas Dr. Megaw states in the summary of his paper[3] "It is concluded that for wavelengths below about 50 cm. electronic oscillations give the greater output", electronic oscillations only giving an output of the order of 1 watt.

In practice, we obtained this type of oscillations on a wave-length ranging from 80 cm. to 5 m. for a two-plate magetron and from 35 cm. to 250 cm. for a four-plate magnetron, whereas Dr. Megaw even mentions measurements on a pure dynatron oscillation of only 600 kc./sec.

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Sept. 25.

[1] NATURE, **134**, 324, Sept. 1, 1934.
[2] NATURE, **134**, 179, Aug. 4, 1934.
[3] *J. Inst. Elec. Eng.*, **72**, 1933.

Fluorine in Coal

A CASE of severe disintegration of porcelain tower fillings over which hot ammoniacal liquor was circulated in a gasworks, caused me to investigate the source of this somewhat puzzling corrosion.

It was found that the attack on the porcelain was due to fluorine, which was shown to be present in the liquor in appreciable quantities (80 parts per million), probably in the form of ammonium fluoride. After eliminating the possibility of other sources of fluorine, I was forced to the conclusion that this element had been derived from the coal carbonised in the gas-making process. On examining a sample of the coal, which consisted of a mixture of Midland and West Country coals, the presence of fluorine was definitely established by the etching of glass.

The existence of fluorine in coal has, I believe, hitherto not been known, or has at any rate not been mentioned in the literature. I have examined a limited number of other coals and have established the presence of fluorine in all of them, in amounts not exceeding one part per million.

The available methods for the quantitative estimation of small amounts of fluorine have not been found satisfactory when applied to coal, but work in this direction is proceeding. Pending the elaboration of a reliable method, the etching test under

controlled conditions gives a good indication of the fluorine content of coal and of the distribution of this element over the coal components.

It has been found that the fluorine content of natural coal dust (containing most of the fusain) is much higher than that of the dust-free coal (vitrain, clarain, durain). This observation indicates that the fluorine is derived from the water which, according to accepted theories, has furnished by a process of infiltration the bulk of the mineral constituents of fusain. On putting this theory to the test, it was found that a small portion of fluorine could be extracted by water and a larger portion by a 1 per cent solution of sodium hydroxide. This distinction proves that the fluorine is mainly present in the form of calcium fluoride.

In one of the coals examined, the chloride content in the dust was three to four times higher than in the dust-free clean coal. As a similar ratio appears to exist between the fluorine contents of the two materials, it is fairly certain that the water with which the coal substance was in contact during or after its formation must be regarded as the source of this element in coal. Moreover, the ratio of fluorine to chlorine in one of the coals examined is of the same order as that found in sea-water. The discovery of fluorine in coals will therefore prove of interest in the study of coal formation.

Its practical importance lies in the direction of eliminating coal components, notably dust, from processes in which an accumulation of fluoride might cause difficulties, as in the case which gave rise to this investigation. R. LESSING.

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Conception of 'Synthesis' in Organic Chemistry

IT is perhaps ungrateful to take exception even in part to so appreciative a note as that on "The Male Sex Hormone" which appeared in NATURE of October 13 (p. 563). However, it contains the following sentence: "It is unfortunate that this conversion of cholesterol into androsterone should be described as a 'synthesis'." Now, the elimination of water from ethyl alcohol is designated as a synthesis of ethylene, and the pyrogenetic decomposition of dipentene is a synthesis of isoprene. These 'partial syntheses' become 'complete' when the starting materials, ethyl alcohol, dipentene, and, in the case of the male sex hormone, *epi*dihydrocholesterol, can be built up from the elements. Naturally, the term 'synthesis' should not be too freely used, but we are nevertheless of the opinion that the first artificial preparation of a sex hormone from a compound with a different number of carbon atoms merits this designation, particularly as we clearly stated in the title of our paper: "Synthese . . . durch Abbau. . . ." L. RUZICKA.

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Zurich.

MY opinion is in no way altered by Prof. Ruzicka's comments. When Prof. Ruzicka has succeeded in preparing *epi*dihydrocholesterol from carbon, hydrogen and oxygen (or from some compound which can be shown to be capable of artificial formation from these elements), I shall endeavour to be the first to congratulate him on having synthesised the male sex hormone (androsterone). I am not concerned with the question whether the transformation of the sterol into the hormone involves a 'building up' or a 'breaking down' of the molecule. The main issue, in my view, is that the term 'synthesis' cannot be justified, either by definition (see, for example, Bailey and Bailey: "An Etymological Dictionary of Chemistry and Mineralogy", 1929) or by common usage, as a description of the conversion into another substance of a compound of purely natural origin. I am sure that the great majority of chemists will agree with this point of view.

In saying this, I am not disparaging Prof. Ruzicka's magnificent achievement. I still have very pleasant memories of a few brief hours spent in his company last March, when he was kind enough to tell me something of the early experiments which have been brought to such a successful conclusion.

THE WRITER OF THE NOTE.

The 'Orthogonal' Matrix transforming Spearman's Two-Factor Equations into Thomson's Sampling Equations in the Theory of Ability

IF φ is a column vector of t elements representing scores in t tests, and s a column vector of $t+1$ elements of which the first, s_0, represents Spearman's g and the rest his specific factors, then $\varphi = Ls$ represents t Spearman equations giving the composition of the φ's, which will in that case be perfectly hierarchical. Here L is an oblong matrix of t rows and $t+1$ columns. Its first column is $\{l_1\, l_2\, .\,.\,.\; l_t\}$ where l_i is the correlation of φ_i with g. The principal diagonal of the remainder of L is $(m_1\; m_2\; .\,.\,.\; m_t)$ where $m^2_i = 1 - l^2_i$. The remaining elements in L are zero.

The transformation $s = \bar{O}y$, where $\bar{O}$ is a slab of an orthogonal matrix O, will transform these Spearman equations into equivalent equations $\varphi = L\bar{O}y$ (where the components y may be of any number not less than t) which will give the same correlations as before. Among the infinity of matrices O there is one, T, the proper slab of which transforms the Spearman equations into equations agreeing with the most probable result of the Sampling Theory, on which theory the complete set of tests formed from all possible linear combinations of the components will be strongly though not perfectly hierarchical, so that a perfectly hierarchical sample can easily be selected, as is in fact done in practice.

The matrix T will be described more fully elsewhere. It is of order 2^t (the slab required being the first $t+1$ rows), is composed of elements like $\pm\, l_1\, l_2\, m_3\, l_4\, .\,.\,.\, m_t$, is axisymmetrical, and has a special kind of reflex symmetry about its vertical and horizontal centre-lines, which can be most readily followed when it is divided into "binomial" compartments by taking the 2^t rows (and columns) in blocks of 1, t, $t\,!/(t-2)\,!2\,!$ . . . (the binomial coefficients). I arrived at it by other means, but Dr. A. C. Aitken has since pointed out to me that it is a Zehfuss matrix and can be made by multiplicative composition (called in America the direct product) of t matrices each of the form

$$\begin{bmatrix} l_i & m_i \\ m_i & -l_i \end{bmatrix}.$$

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Oct. 6.

Difficulty of Long-Wave Transmission in Summer

THADÉE PECZALSKI has developed a theory of sub-electrons[1] which explains the absorption of electromagnetic waves by charged small particles. The result, it seems to me, can be found intuitively, so to say, by considering Langevin's formula for the energy of radiation of an electromagnetic wave when a particle of mass M carrying a charge e collides with a gas molecule of mass m. The energy ε is given by

$$\varepsilon = \frac{2}{3}\frac{e}{c}\int_{t_1}^{t_2} \Gamma^2 \, dt$$

This function Γ is regular, that is, uniform and continuous in the interval of integration. A function of this type translates into the language of function theory the principle of conservation of momentum and energy. The arguments of the function undergo transformations that maintain a certain invariance of the function due to the quadratic form of the integrand. Here the asymptotic method[2] may be utilised, as we are concerned with a periodical phenomenon. The function expressing the kinetic energy has been shown by Peczalski to be

$$\varepsilon_1 = \frac{2}{3}\frac{e}{c}\,(eF)\,t\,\triangle t,$$

where F is the external field, $\triangle t$ the period between two successive impacts of a molecule and a charged particle. An asymptotic series will approach a limit; in this case the limit will be $\bar{\varepsilon} \rightarrow RT/N$ with the well-known meanings of R, T and N. The Planck formula of radiation

$$\bar{\varepsilon} = h\nu \,/\, (e^{KN.h\nu/RT} - 1)$$

shows that ν should be very small, that is, the radiant waves must be very long. The small particles carrying charges will be absorbing energy like resonators (Peczalski's result).

In summer conditions, when the sun is shining, photoelectric processes will produce electrons and sub-electrons which collide with the molecules of air and act as resonators absorbing the energy of long electromagnetic waves.

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Sept. 8.

[1] *C.R.*, July 4, 1927.

[2] NATURE, **134**, 216, Aug. 11, 1934. A misprint occurring there may be corrected: for $\psi \sim e^{\lambda s} - \left(v_0 + \frac{v_1}{\lambda} + \quad . \quad . \quad . \quad .\right)$ read

$$\psi \sim e^{\lambda s}\left(v_0 + \frac{v_1}{\lambda} + \quad . \quad . \quad . \quad .\right).$$

Physico-Chemical Test for Mitogenetic (Gurwitsch) Rays

UNTIL now, there has been only one physical method for detecting Gurwitsch rays, namely, with the Geiger-Müller electron counter. Using this method, some workers[1] have got positive results, whilst other investigators[2] have not been able to confirm them. The method needs complicated apparatus which is difficult to manage.

Therefore I have tried a simpler method to test for the existence of the so-called mitogenetic rays, without using biological objects. Inorganic colloidal solutions—charged either negatively or positively, and made unstable by the addition of neutral salts—flocculate more rapidly when influenced by mitogenetic rays. The duration of irradiation is very important to get good effects. At first I used colloidal solutions of iron hydroxide, the turbidity of which had been produced by potassium chloride solution of a fixed concentration, and which afterwards were exposed to the influence of Gurwitsch rays. The increase of turbidity after a certain time indicated the presence of the mitogenetic rays; the turbidity was measured with an electrical nephelometer. Afterwards it was found that better and more regular effects can be obtained by using gold sol. The gold sol, which should be clear and red, was prepared with hydrogen peroxide. The change of colour of the irradiated samples in comparison with the non-irradiated ones can be perceived sometimes macroscopically. Measurements of the turbidity in an electrical nephelometer have, however, proved more convenient and more reliable.

As sources of radiation, comparatively slow chemical actions (sodium chloride dissolving in water, urea-urease) and human blood were used. The result of one experiment is given below. The gold sol was in Petri dishes, covered by dishes of quartz, and exposed for two minutes to crystals of sodium chloride in water. Measurements made with the nephelometer:

	Control	Induced
4 min. after the end of irradiation	80	96
7 ,, ,, ,, ,, ,, ,,	82	103

The same without irradiation, both as controls:

3 min. after the end of the experiment	80	80
6 ,, ,, ,, ,, ,, ,, ,,	82	85

Full details will be communicated elsewhere.

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[1] Rajewski, "10 Jahre Forschung auf physikalisch-medizinisch. Grenzgebiete", 1931. Frank and Rodionow, *Naturwissen.*; 1931. Siebert and Seffert, *Naturwiss.*; 1933. Ruyssen, *Natuurwetenschap. Tijdschrift*, No. 6; 1934, has not yet finished his investigations. Barth, *Arch. Sci. Biol. Lenin.*, **35**, 1934.

[2] Seyfert, Dissertation, Tübingen, 1932. Locher, *Phys. Rev.*, 1932. Lorenz, Public Health Reports, Washington, 1933, and *J. Gen. Physiol.*, **17**, No. VI; 1934. Schreiber and Friedrich, *Biochem. Z.*, 1930. Gray and Ouellet, *Proc. Roy. Soc.*, B, 1933.

Reduction of Traffic Noise

THE report in NATURE of October 20, p. 633, of a discussion on this subject at the recent meeting of the British Association at Aberdeen encourages the hope that the attention of competent minds directed to the reduction of sound in motor traffic may have practical results.

Nevertheless those who, like myself, knew London sixty years ago, may remember that its streets were far noisier then than they are now. At that time they were all either paved with stone or laid with macadam; all vehicles ran upon metal tyres and were drawn by iron-shod horses. The result in rumbling and clatter was far in excess of what we complain about now.

HERBERT MAXWELL.

Monreith.

Research Items

Man or Ape? In view of the difficulty which has been felt in determining the position of the Taungs skull in relation to man and the anthropoids, Dr. Paul Alsberg of Berlin puts forward in *Man* of October a suggested criterion for deciding on biological lines whether in an indeterminate instance, such as the Taungs skull, the specimen is to be assigned to the human or anthropoid branch in the line of descent. Biologically, man and the animal develop on diametrically opposite principles. The animal develops by physical or organismal adaptation, man by extra-physical or non-organismal adaptation, that is, by the liberation of the body from the necessity of adaptation through extra-physical means, for example, tools. The animal possesses a perfect body with manifold structures for offence and defence; while man's body is utterly defenceless and helpless. His technique develops and replaces his adaptation to Nature; and as evolution proceeds, his technique becomes more perfect, while his body becomes more and more deficient. The development of technique is not limited to tools, but is also revealed in the mental province, being responsible for the development of the word, speech and the concept, the basic element of thought. Further, the body, owing to the use of tools and the principle of body liberation, has suffered both regressive and progressive changes, such as the retrogression of the jaws, or the modifications produced by upright walking, the improvement of the hand, the development of the speech organs and the enlargement of the brain. The ape, on the other hand, has taken the line of animal adaptation. Thus the ape's hand, originally better adapted for tool using, developed for climbing. Again, the upright gait is bound up with the fight principle, but while the gorilla developed or retained equipment for fighting, man did not. Judged by these criteria, a border line case such as *Pithecanthropus erectus* is definitely human, while the Taungs skull points in the human direction.

The Later Stone Age in Northern Ireland. The first of a series of projected papers by Mr. C. Blake Whelan, dealing with the place of the stone age of northern Ireland in a provisional synthesis of late mesolithic and later stone age industries, has appeared (*Proc. Roy. Irish Acad.*, 42, Sec. C, No. 7). While a number of closely related mesolithic industries are differentiated as 'pseudo-Campignian', 'pre-Campignian' or 'proto-Campignian', as well as Campignian, the value of the Continental material is affected by the fact that this shadowy sequence has not received clear stratigraphic confirmation. In Northern Ireland, however, such a stratification is to be found in the Northern Irish coastal sites. These sites are now being investigated by the Harvard University Archæological Mission, which will test the provisional conclusions to be advanced here. It would appear that from the earliest stages of the Littorina transgression, a succession of differentiated, but related, littoral cultures, emanating from some eastern focus over a prolonged period, reached the Irish shores. However marked the separation of these industries in facies and time, there is a technical continuity which is unmistakeable. The groups represented comprise analogues of the Orwell Estuary industry called "Magdalenian", the so-called "Azilian" of Campbelltown raised beach, the pseudo- and pre-Campignian of the French sites, certain Portuguese Asturian forms, the shell-mound industry of Denmark and lastly the classical type station of Campigny. The Campignian site of Ballynagard, Rathlin Island, is now described. Here with characteristic implements of pure Campignian facies the author has discovered locally polished axes associated with pottery of veritably Windmill Hill type. Ballynagard is thus brought within the great western culture group of the neolithic, exemplified in the ceramic groups of Windmill Hill, Chassey (France) and Michelsberg (south-west Germany).

Fish Eggs and Larvæ from the Java Sea. Under this title, Dr. H. C. Delsman continues his studies on the eggs and young of fishes (*Treubia*, 14, No. 2, 1933). Eel eggs are fairly common in the surface catches with the egg net and may be recognised by their large size, segmented yolk and spacious egg membrane. The most numerous are those without an oil globule, which probably for the greater part belong to the many species of *Murœna* inhabiting especially the coral reefs. Those eggs which possess an oil globule are very interesting, hatching out into larvæ developing black spots ventrally, similar to those studied by Raffaele, Einigmann and others and shown to belong to larvæ of different species of ophichthyids. One of these in the present material is probably *Ophichthys macrochir*. If this be correct, there must be a forward movement of the anus over a distance of at least ten vertebræ. A similar conclusion was reached by Schmidt and by Grassi for *Ophichthys* (*Ophisures*) *serpens* from the Mediterranean. Other eggs and larvæ possibly belong to *Pisoödonophis*, the commonest ophichthyids along the coast of Java. Here again a forward shifting of the anus over several vertebræ must take place. Amongst the clupeoid eggs is a large one, found in brackish water, probably a species of *Alosa*, two of which (known as *trubuk*) occur in the river mouths of Sumatra and Borneo. These are related to the shads, but unlike them, appear to spawn in brackish instead of fresh water and have several oil globules in the eggs and newly hatched larva, the ovaries of the *trubuk* being rich in oil.

Cyclostomes. A concise systematic survey of the Cyclostomata is given by Dr. M. Holly in "Das Tierreich", 59 Lief., pp. xii + 62 (Leipzig and Berlin: Walter de Gruyter und Co., 1933). The class is defined and the chief anatomical characters are briefly described. The classification follows on recognised lines into two orders, two families, eleven genera and forty-one species, the discrimination of which is aided by the usual tabular keys. Two other species are regarded as doubtful. The work is illustrated by 57 figures in the text.

Chromosome Division in Grasshoppers. There is some divergence of opinion regarding the behaviour of the chromosomes of the grasshopper and its interpretation, and an investigation by T. Ramachandra Rao upon the spermatogonial divisions of *Aularches miliaris*, supports the observations of McClung and others (*Proc. Indian Acad. Sciences*, 1, No. 1, 19; 1934). The rod-shaped chromosomes numbered 19, a standard number for the males of all the members

of the sub-family Pyrgomorphinæ. Individual chromosomes are built of fine threads—the chromonemata—and these are double in the telophases, become very thin and reach the limit of visibility during the resting stage, and show a spiral structure in the prophases. Each chromosome is confined to a chromosome vesicle, formed in the interphase owing to the limited centrifugal movement of the chromosome matrices, and it is after the gradual thickening and uncoiling of the chromonemata leading to the late prophase chromosomes that the vesicles break down.

Common Weeds of the Chicago Region. A very attractive booklet on "Common Weeds" by Paul C. Standley, associate curator of the Herbarium, has recently been issued by the Field Museum of Natural History, Chicago. Though it is interesting to note that several of the plants described are found as weeds in Great Britain, most readers will be struck with the high pictorial quality and attractiveness of the illustrations, of which there are twenty-seven. The printed descriptions are short, and describe the most-favoured habitat of the species, the country of origin if introduced, and the manner of seed dispersal. No attempt is made to deal with methods for the eradication of weeds; indeed the author is intent on mentioning any possible use the plants may have. Many people will be interested to know, for example, that the leaves of the yellow dock, which is the same species as our English curled dock (*Rumex crispus*), can be gathered in spring, and cooked and eaten as greens.

Fermentation of Mushroom Hotbeds. The use of fermenting manure as a source of heat for the cultivation of mushrooms and other crops has been a standard horticultural practice for a long time. Successful hotbeds require skilled compounding and attention, but little is known about the bacteriology of the process. An article on the "Distribution of Oxygen and Carbon Dioxide in Mushroom Compost Heaps as affecting Microbial Thermogenesis, Acidity and Moisture therein" by Edmund B. Lambert and A. C. Davis (*J. Agric. Research*, 48, No. 7, 587–601, April 1934) reports a preliminary study of the process of fermentation. It was found that in general, fermentation is anaerobic below a foot from the top of the heap and three feet of the sides. The highest temperatures were found 1–3 ft. from the top and 2–4 ft. from the sides of the heap. Compost in the anaerobic part of the heap tends to be acid, whilst aerobic conditions produce alkalinity. The introduction of ventilating tiles at ground-level permits air to enter the central parts of the heap, and raises the temperature there. It is not known if this will improve the yield of mushrooms; but it opens up interesting possibilities for the control of insect pests which flourish in the cooler places at the base of the heap.

Cultivation of Animal Fodder. The Imperial Bureau of Plant Genetics has just issued a new booklet in the Herbage Publication Series, "Grassland and Forage Crops in Thuringia, Czechoslovakia and Hungary" (Bull. No. 15, 3*s*. 6*d*.) The area under review is situated in long. 10°–23° E., lat. 46°–51° N., the type of fodder cultivated depending on two chief factors, namely, climate and elevation. The climate may be divided into two main types, the maritime (Atlantic) and the continental (Russian). Two important continental areas at low elevations and with rich soils are the Alföld and Thuringian Basin, and it is here that the most important lucerne strains are to be found. The chief aim in the breeding work in these districts is the maintenance of high yield combined with the ability to withstand excessive cold and drought. At the other extreme as regards altitude are the mountain pastures of Thuringia and eastern Czechoslovakia (Slovakia and Sub-Carpathian Ruthenia), where the economic problem is the substitution of the *Nardus stricta* and related poor quality swards by better quality grasses capable of persisting under these conditions. The articles on each district have been prepared in collaboration with acknowledged authorities in the region concerned. It is hoped to extend these studies to other European countries in which the cultivation of animal fodder represents an important part of the national economy.

The Development of the Rhone Delta. In 1930, Mr. R. D. Oldham showed that the present deltaic character of the Lower Rhone was a very late development in the evolution of the river. He is now able to give an outline of the whole history of the Lower Rhone (*Quart. J. Geol. Soc.*, pp. 445–461; 1934). In the Pleistocene, the river had already established its course through a gap between the Alpine and Beaucaire hills, but the present channel through the delta was not open, as a barrier blocked the way and forced the stream westwards. About 600–700 B.C., changes of level occurred which resulted in the formation of a lake (Accion) and involved the submergence of the lowlands near the sea. Some time after 500 B.C., the river built up its channel across the Accion, and floods rose higher against the banks until the barrier was overtopped a little upstream of Arles. A new channel to the sea was thus formed and by 218 B.C. it had become well established. In the eighth century of our era, a fresh movement brought about a subsidence of 15–20 ft. along the line of this new eastern channel, with consequent changes in its course as the flooded areas were gradually reclaimed by river silt. Along the older western branch a more direct channel to the sea was opened up past Albaron and the older course became blocked up and was abandoned. The delta of the Rhone may be said to have begun at this time, since when its development has been normal except in so far as it has been recently controlled by embankments.

Plessey Coal Seam, Northumberland. The Department of Scientific and Industrial Research has issued Paper No. 34 of the Physical and Chemical Survey of the National Coal Resources, dealing with the Plessey seam in Northumberland (London: H.M. Stationery Office. 2*s*. net). This seam, though only of comparatively limited area and low down in the series, is especially valuable because, as the report states, it yields a good quality of clean hard coal, hard enough to stand transport, and it is, therefore, mainly marketed as a steam and bunker coal. As it is a dull coal, it is not much used for household purposes. The report gives a full account of the seam and its properties, shown by fourteen analyses of samples of the coal together with some four special analyses. The report is of course mainly of interest to the few collieries working this seam, but may attract wider notice through the fact that this seam played an important part in the history of the

Northumberland coalfield and really started coal shipments from the port of Blyth, which has now become a very important coal-shipping centre.

Meteorology of Greenland. Geophysical Memoir No. 61 of the Meteorological Office, Air Ministry, is the fullest account that has yet been given of the meteorological results of the British Arctic Air-Route Expedition, 1930–31. The available material has been worked up by Mr. S. T. A. Mirrlees, of the Meteorological Office. The expedition was not, of course, undertaken with the view of finding out more about the part played by the high land mass of Greenland in the formation and behaviour of the depressions of the North Atlantic, and its significance in connexion with the streams of cold air that spread down from the arctic regions and are responsible for so many of the spells of cold weather in Europe that are initiated by strong winds or gales from between west and north. Nevertheless, to meteorologists this is perhaps the most important problem that the observations might help to solve. The expedition maintained a base station near the head of a fjord not far from Angmagssalik, in East Greenland, from August 1930 until July 1931, and for part of that time on the inland ice-cap at lat. 67° 3′ N., long. 41° 49′ W. Mr. A. Courtauld performed a remarkable feat of endurance by maintaining, alone, all the observations at this inland station from December 5 until March 20, and—after being snowed up—took indoor observations until May. It is difficult in a short space to give a proper idea of the knowledge gained; some of this is of a negative character; for example, the failure to correlate the violent northerly hurricanes experienced at the base station with subsequent gales in the Atlantic. These hurricanes were thought to be only partly katabatic, and, as happens with katabatic winds in some other parts of the world, are usually associated with a pressure gradient having the appropriate direction and yet cannot be relied on to appear when such a gradient is present. The cup anemometer at the base was blown away in one of these, after recording a speed of 129 miles an hour. The main object of the expedition led to particular attention being paid to visibility. On the ice-cap, this was often bad near the ground owing to drifting snow, but on one occasion a cape 220 miles away was identified by an observer in a seaplane, and on another visibility aloft was 180 miles, these observations both being made at 10,000 ft. in late summer.

Accurate Wave-Lengths in Stellar Spectra. Dr. S. Albrecht has published the results of a detailed study of Procyon with a three-prism spectrograph at Yerkes Observatory (*Astrophys. J.*, 80, 86). The object is to obtain accurate wave-lengths of as many spectral lines as possible for use in determining radial velocities of stars of similar spectral types (*F*5 dwarf). The wave-lengths in stellar spectra cannot be computed from laboratory values, since, owing to the comparatively small dispersion used, a large number of the observed lines are blends of two or more lines in unknown proportions, and must be measured directly in the stellar spectrograms. Wave-lengths are given to 0·001 I.A. for 1,094 lines (about one third of which are due to Fe) in Procyon. The probable errors, intensities, widths and identifications (when possible) are also given, together with all data which would be necessary if a future rediscussion of the wave-lengths and radial velocities should be desirable. The work is a continuation of a series of similar studies of standard stars covering classes *Ao* to *Mb*, the first of which (on γ Geminorum, class *Ao*) was published in 1930.

Dissipation Constants of Solids. If a bar of carefully annealed aluminium is held in the middle and one end is struck, the sound emitted can be heard for a minute afterwards. If the same is done to a bar of lead, no musical note is emitted. There is therefore a great difference in their behaviour towards mechanical vibration. In the case of aluminium, the energy is gradually radiated into the air. In lead the vibrations die out so quickly that within one tenth of a second of being struck the displacement at the end of the lead bar is reduced to about one millionth of its original value. Researches on this subject described in the *Bell Laboratories Record* of August by H. Walther show how to distinguish between the way bodies act in this respect by means of a 'dissipation constant'. The results show that typical solid materials have a wide range of values for this constant. In some cases the results are surprising. For example, of two bars of steel identical in size, shape and composition, one of which is hardened by heating and quenching and the other softened by careful annealing, it is found on tapping their ends that it is the soft one that rings the longer. The constants for most solids lie between the two extremes of lead and aluminium. The figures given indicate orders of magnitude rather than specific values, since for a given material appreciable variation is possible under various conditions of internal strain. It is curious to notice that the order in the list given seems to bear no relation to other physical properties of the body. Carbon and tin have much the same values for the dissipation constant, but their melting points are very different. Zinc and glass differ greatly in hardness and electrical resistivity, but their dissipation constants are nearly the same.

Fatigue Properties of Patented Steel Wire. The importance of the surface condition on the fatigue resistance of steel has been shown conclusively in several recent publications. The importance of this in the production and use of steel wire has led E. T. Gill and R. Goodacre (*J. Iron and Steel Inst.*, 130, Advance Copy; 1934) to undertake a comprehensive study of the effect of decarburisation with the aid of the new Haigh-Robertson fatigue testing machine. They have shown that the effect of the decarburised surface, especially for higher percentage reductions by drawing, is sufficiently great to obscure completely the effect of the carbon content. The removal of this skin results in the fatigue limit increasing, as would be expected, as the carbon content of the steel is raised, but not to so great an extent as does the tensile strength. Under certain conditions, the fatigue properties have given an indication of the stage at which overdrawing of the wire occurs, but much more work is required before any generalisation is possible. An interesting feature of the work is the suggestion that the endurance properties of wire under high stresses undergo critical changes at certain reductions of area, an effect to which the authors are inclined to ascribe certain unexpected failures in wire ropes. They also make the interesting suggestion that although the fatigue limit of wire free from decarburisation is higher than that of decarburised wire, the endurance at stresses higher than the fatigue limit, at any rate in some cases, may be less.

Physiology and Pathology of Blood

THE active state of research on blood was well shown by the symposium held at Aberdeen on September 6 by Section I (Physiology) of the British Association. The four papers which were presented at the meeting ranged from matters of practical importance to medicine, such as the incidence of anæmia amongst the poor of Aberdeen, to problems of—at the moment—purely scientific interest such as the molecular weight of the blood pigment, hæmoglobin, in different species; this short account of the discussion may well begin at the medical angle of the discussion, and travel gradually over to the more academic aspects.

Prof. L. S. P. Davidson (Aberdeen) emphasised the importance of nutrition in the etiology of blood diseases. As regards the anæmias which arise from nutritional diseases, these can be sharply divided into two groups: (*a*) A group of diseases, which are severe, though comparatively rare in incidence, and respond to feeding with liver or liver extract but not to iron. (*b*) An extremely common group with low mortality but high loss of economic efficiency. These respond to feeding with iron. A deficiency of iron or of the specific anti-anæmia factor found in liver may occur through (i) actual deficiency of the factors, or of their precursors, in the diet; (ii) imperfect digestive processes either leading to failure in the manufacture of the factors or rendering them unavailable; under this heading specific deficiency in gastric secretion has been shown by Castle and others to be of clear importance; (iii) defective absorption from the intestine; (iv) demand being excessive, though the supply is normal, as in pregnancy.

Prof. Davidson has found amongst the poor of Aberdeen that roughly 50 per cent of adult women and of infants up to the age of one year are anæmic, though children between the ages of five and fourteen years and adult men are rarely so. The diet was the same in all these cases, but was relatively low in iron: the anæmia in the women and young infants is therefore attributed mainly to the excessive demand for iron in these two cases, due either to rapidity of growth or to loss of blood at child-bearing age or menstrual periods. Prof. Davidson concluded by describing the steps which a practising physician should take when faced with a case of anæmia.

The main theme of the paper by Prof. J. Barcroft (Cambridge) was the oxygen supply to the blood of the developing fœtus. At the beginning of gestation, the placenta is large relative to the size of the fœtus, but the growth of the fœtus soon catches up with the placenta, and by term it may well be that the fœtus has outgrown its commissariat.

The matter has been investigated quantitatively by measurement of the oxygen content of maternal and fœtal blood. Several compensatory mechanisms seem to have been adopted to cope with the relatively poor conditions of oxygen supply to the fœtus. (i) The maternal blood becomes more acid, thus being enabled to part with its oxygen more readily. (ii) The hæmoglobin of the fœtus differs from that of the mother in that it has, under identical conditions, a distinctly greater affinity for oxygen. (iii) In certain animals (for example, rabbit) the maternal and fœtal blood vessels are anatomically arranged in such a way as to ensure maximum diffusion of oxygen from the maternal blood to the fœtal blood. The extraordinary efficiency of these arrangements is shown by observations on the oxygen content of the blood returning from the uterus to the venous system of the mother. As pregnancy advances, the content sinks until at term the blood is almost denuded of oxygen.

Even so, the oxygen in the fœtal blood feeding the fœtal organs does not reach a level as high as would be found in the arteries of a man at the top of Mount Everest; it is doubtful indeed whether the fœtal oxygen level would be enough to maintain consciousness in the born animal. The fœtus, however, appears to be better off, in that the oxygen consumption of its tissues, per unit weight, may be only about a third of the oxygen consumption per unit weight after birth.

Dr. F. J. W. Roughton (Cambridge) gave a summary of recent work on the transport of carbon dioxide in blood from the tissues to the lungs. The pioneer work of Henriques in 1928 first directed attention to the need for studying the kinetics of the reactions of carbon dioxide in blood. This new orientation has resulted in two new lines of work.

(*a*) The discovery of an enzyme in the red blood corpuscles capable of accelerating both phases of the reversible reaction carbonic acid $\rightleftharpoons$ carbon dioxide + water. The enzyme has been separated in a high state of activity, and has been given the name carbonic anhydrase. Without this enzyme, most of the carbon dioxide to be eliminated from the animal could only escape from the blood at about one fiftieth of the rate at which it is actually excreted in the expired air. The amount of enzyme in the corpuscles is, however, sufficient to accelerate the rate of carbon dioxide elimination about a thousand-fold, if the activity of the enzyme in the corpuscle is the same as in solution. The enzyme is not present in appreciable amounts in the normal blood plasma; its absence therefrom means that, whilst the blood is actually passing through the capillaries, that part of it which is in closest proximity to the tissues, that is, the plasma, suffers even less change in acidity than had been hitherto thought. Nor is the enzyme present in most organs: Dr. Roughton gave reasons why its presence in the actual tissues would *reduce* rather than increase the rate of removal of carbon dioxide by the blood. Organs where its presence would be, however, an advantage, are those in which bicarbonate, as well as carbon dioxide, is excreted, such as the pancreas (via the pancreatic juice). Here the enzyme is found in large quantities.

(*b*) The demonstration of a direct reversible reaction between carbon dioxide and hæmoglobin of a carbamino type, namely, $HbNH_2 + CO_2 \rightleftharpoons HbNHCOOH$. The indirect evidence for the occurrence of this reaction in blood has recently been strengthened by the work of Ferguson and Roughton, who claim to have separated and estimated the compound by taking advantage of the fact that its barium salt is soluble and stable in alkaline solution. Owing to the greater ease with which reduced hæmoglobin forms such compounds than oxyhæmoglobin does, an appreciable fraction, possibly 20 per cent, of the carbon dioxide carried by the blood during the respiratory cycle is believed to be transported via this carbamino-CO_2-hæmoglobin mechanism,

which works quite independently of carbonic anhydrase. Dr. Roughton, in a concluding survey of the present experimental evidence, suggested that there might be at least one more chemical mechanism for carbon dioxide transport in blood besides those already postulated.

Dr. G. A. Millikan (Cambridge) gave a useful résumé of Svedberg's work upon the molecular weight of the respiratory pigments. The values obtained in different animals range from 17,000 in the *Chironomus* larva to 5,000,000 in the edible snail and most gastropods. The physiological significance of the enormous variation was discussed. Dr. Millikan then described in detail the properties of the newly isolated muscle hæmoglobin, with particular emphasis upon the striking respects in which it differs, as regards its reactivity, from blood hæmoglobin. This led him finally to a survey of present theories as to the nature of the equilibrium between oxygen and hæmoglobin. F. J. W. R.

Distribution of Marine Animals and the History of the Continents

HOW the past history of the great land and water masses of the earth's crust is reflected in the distribution of many marine animals was the subject of an important paper read by Prof. J. Versluys on September 7 before Section D (Zoology) of the British Association meeting in Aberdeen.

Prof. Versluys directed attention to the fact that the presence of a considerable number of closely allied marine animals and even specifically identical ones on both sides of Central America and in the Indian Ocean and European Atlantic points conclusively to the presence of former sea connexions linking up the Atlantic, the Pacific and the Indian Oceans. These connexions lay across Central America and through a bygone sea called Thetys, along the region where Asia and Africa now unite. In elaborating this thesis, he dealt mainly with the curious distribution of a small family of deep-water horny corals, the Primnoids.

In spite of the great land barrier now separating them, the Primnoid fauna of the European Atlantic is very similar to that of the Indo-Malayan seas, every species in the one region being represented by corresponding and, in part, closely allied species in the other. This is due to the fact that these two regions were in communication by way of the Thetys until the middle of the Tertiary period—a date so recent that no great changes in the Primnoid fauna have since then taken place.

The West Indian Primnoids, on the other hand, differ more widely from the European ones than do those of the Indo-Malayan region. Prof. Versluys suggested that this is explained by the intervention of the big Atlantic basin which, for Primnoids with their very ineffective means of dispersal, must act as a considerable barrier to distribution. Nevertheless, the difference between the West Indian and European Primnoids, though considerable, is not so great as might on this account have been expected. The Central Atlantic formerly had a continuous southern coast, Brazil and West Africa being united, so that conditions for dispersal between European seas and the West Indies were more favourable in times past than they are now.

Contrary also to what one would expect, the West Indian fauna of Primnoids bears but little resemblance to that of the American Pacific coast, no closely allied species being known from both regions. This applies not only to the Primnoids of these regions but also to the Gorgonacean corals as well. The old Central American connexion was, for some reason, not favourable to the distribution of corals across it.

Again, the American Pacific fauna of Primnoids shows no close relationship with the Indo-Malayan and Japanese fauna. There are a few species in common—indicating a migration across, or more probably around, the Pacific—but a number of important genera have very different species in the two regions, proving that, on the whole, distribution has been restricted and that these faunas must have been separated by the large Pacific basin for a very long time.

In view of these findings, Prof. Versluys is confident that Central America is, and has been, the most formidable distributional barrier encountered by the circum-tropical fauna of Primnoids. The Pacific Ocean also was, and is, an important barrier, but the present obstacle provided by the Africa-Asia continent was absent in pre-Tertiary times when the Thetys offered favourable conditions for the dispersal of Primnoids—so much so that Indo-Malayan forms seem to have reached the West Indies by way of this ancient sea and the then smaller and circumscribed Atlantic.

In support of these conclusions, comparison was made with the distribution of sea urchins. In spite of the fact that these animals live in shallower water (where stronger currents usually occur) than do the Primnoids, and have specialised pelagic larval stages of some duration which can be transported over long distances by water movement, the sea urchin faunal regions in the tropics and sub-tropics are the same as those of the Primnoids. The Atlantic again has proved but a feeble barrier. Of about eighty West Indian species, 19 are found also in the European Atlantic. On the other hand, there is no species of sea urchin known from both sides of Central America, and the tropical American Pacific coast has no species in common with the Indo-Malayan region.

The Primnoid fauna of the southern oceans also has a curious distribution, the explanation for which must be sought in the geological formations of earlier times. The southern Primnoids, especially those of the genus *Primnoella*, are found at a number of stations widely separated from one another by stretches of sea that must be scarcely passable for these corals with their very limited means of distribution. Moreover, of the entire southern fauna of Primnoids, only two—species of *Parathonarella*—are recorded from South Africa. The simplest explanation of this curiously scattered distribution, according to Prof. Versluys, is offered by Wegener's well-known theory of the splitting up of a southern continental mass known as Gondwanaland, the parts of which drifted away from one another to form South America, Australia, Africa, part of India and the antarctic continent, with some intermediate small islands representing parts that split off from the drifting mainlands and were left behind.

G. A. S.

Experimental Method in Industrial Relations

AN interesting discussion arranged by the Department of Industrial Co-operation of Section F (Economic Science and Statistics) at the Aberdeen meeting of the British Association dealt with the use of the experimental method in the field of industrial relations. It would probably have attracted more attention had it not been postponed to the last morning of the meeting.

The three papers forming the basis of the discussion were all highly stimulating and suggestive. Mr. M. H. Dubreuil's paper on autonomous groups in industry was essentially a plea for greater delegation of responsibilities in industry as a means of associating the workers with the success of the business which employs them. M. Dubreuil pointed out that this involves the discovery of responsibilities in accordance with the character and extent of the special abilities of the worker, and not in accordance with the abilities possessed by persons in the business entrusted with quite different tasks. The secret of scientific progress in the internal organisation of work lies in these terms of differentiated abilities.

Many problems of equipment, distribution of work, supplies, processes, etc., outside the scope of the abilities of the general manager could usefully be appreciated by the workman, and M. Dubreuil envisaged the subdivision of the business into relatively autonomous groups corresponding to the various tasks revealed by analysis of its technical structure. To this technical subdivision might be added a subdivision of the general budget, so that members of each group might act as if they really formed an independent business, thus ensuring an interest in the profit ensured by the good management of the fraction of the budget entrusted to them. M. Dubreuil believes that organisation of work on these lines is to be preferred to many profit-sharing systems.

This plea for experimental study of the structure of industrial organisation was followed by another striking paper, by Prof. F. Meyenberg, on the improvements in industrial relations arising from the intervention of the management consultant. Prof. Meyenberg pointed out that the independent consultant possesses definite advantages. He is not tied to a daily routine and can give his whole time to questions of organisation. Being free from departmental bias, he can keep in view the harmony of the whole organisation. Moreover, his experience in different branches of industry makes it easier for him to recognise common principles and to avoid undue attention to relatively unimportant details. In addition, since such a consultant is concerned primarily with the large field of management and not with questions of technology or production, any essential knowledge of the particular trade required to avoid difficulty in the introduction of management methods can easily be acquired by a man of the ordinary technical education essential for any consultant. These advantages and the freedom from the deadening effect of tradition on those who have spent long years in an industry give the management consultant a wide sphere of service in industry which is far from being generally appreciated or utilised.

In Prof. Meyenberg's opinion, some of the prejudice against the use of an outside consultant is due to the fact that the wrong man has sometimes been called in. This is probably a less important factor than the conservatism of the average industrialist, but the importance of the quality of the consultant needs no emphasis. Prof. Meyenberg made the further suggestion that such consultants might be recruited from the captains of industry themselves.

The third of the three papers, that of Mr. R. J. Mackay, was concerned with experiments in readjustment of relations between finance-capital, management and operative labour. Mr. Mackay pleaded for experiments in reversal of the customary relations between absentee owners and working personnel, such that capital will only be attracted if the capitalist has confidence in the efficiency of the team which desires to hire his capital. Among other rather revolutionary suggestions in an admirable plea for the improvement of the relations between capital, management and labour, Mr. Mackay submitted a case for the division of medium- or large-sized businesses into relatively independent responsible groups of working personnel, and indicated its bearing upon the wider utilisation of biological laboratory technique for vocational selection, guidance and placement of existing and potential industrial personnel of all qualities.

These three thoughtful papers pleading for wider use of experimental methods in studying the structure and development of industrial organisation give a highly significant picture of the wide field which industrial management offers for the use of scientific methods. The future of industry, and to a large extent the structure of society, are bound up with the application of impartial studies in this field, and the Department of Industrial Co-operation is to be congratulated once again upon the way in which it has attempted to indicate the possibilities in this direction to the British Association and to the public.

American Stratosphere Ascent of July 29, 1934

A BRIEF account was given in NATURE of July 28, 1934, p. 132, of a projected American ascent into the stratosphere in the balloon *Explorer*, jointly organised by the National Geographic Society and the U.S. Army Air Corps. The following week it had to be recorded that the flight had failed, but that the pilot, Major W. E. Kepner, the observer, Capt. A. W. Stevens, and the alternate pilot, Capt. O. A. Anderson, had escaped by parachute from the falling balloon. Most of the valuable instruments were completely destroyed; but it would now appear that many of the records made on photographic strip have been saved.

Some of these results have recently been described in London at the International Conference on Physics in a contribution by Bowen, Millikan and Neher, while in the *National Geographic Magazine* of October Capt. Stevens contributes an article on the general aspects of the flight from which some further ideas of the faultless organisation and mechanical skill of

the enterprise may be obtained. The whole was a triumph of self-registration devices. Contributions of instruments were made by educational and other institutions in many parts of the United States. There were tubes of spore cultures, three spectrographs, one for ozone, one for sky and one for horizon; three electroscopes for cosmic ray ionisation, one exposed, one inside 4 in. of lead shielding and another weighing 600 lb. with a 6 in. covering of lead. These were contributed by Millikan and Neher. A contribution by Swann and Locher was a counter apparatus arranged for recording cosmic ray intensity from four different directions from the vertical to the horizontal. There were coarse and inter-range barometers for recording pressure variations automatically at high altitudes, and a dozen or more parachutes for men, heavy instruments and gondola.

Besides a perfect barograph record of the event which shows that a minimum pressure of 60 mm. was reached, electroscope records of cosmic ray ionisation from ground-level to 60,000 ft. were obtained. These have led Millikan to the conclusion that the only source of the observed cosmic ray energies now in sight is matter annihilation: most of the ionisation observed at sea-level is due to incoming photons produced during the destruction of matter in higher altitudes. Records of sun and sky brightness, internal and external temperature, the altitude of the inversion of the temperature gradient between 20,000 ft. and 38,000 ft., were also obtained. Capt. Stevens concludes by saying, "our most cheering thought of the recent ascent is that we feel we have successfully solved the problems of living and working efficiently in the stratosphere . . . not a single piece of scientific equipment attached to the gondola failed us during the flight; every instrument worked exactly as planned".

The mishap was due to a rip in the lower part of the balloon which was first noticed at the highest altitude. The men owe their lives to the perfection of the carefully designed scalloped band attached to the balloon fabric to which the gondola was roped. This band held the balloon steady in a drop of about 55,000 ft. in about 1½ hours and kept the rips from extending.

Inheritance of Anatomical Structure in Plants

THERE have been very few investigations of the inheritance of anatomical structure in plants. A recently issued work by E. W. Sinnott, Helen Houghtaling and A. F. Blakeslee* is a contribution to this subject, based on a comparison of the vascular anatomy in, (*a*) the polyploid forms of *Datura* (n, $2n$, $3n$, $4n$), and (*b*) the 12 trisomic ($2n+1$) mutants and such of their secondaries as were available. Among the few earlier studies, the authors have overlooked the work of Penhallow on the anatomy of a hybrid *Catalpa*, and the papers of Gates and Bartlett on cell measurements in tetraploid *Œnothera*.

The flower pedicel was chosen for anatomical study, as comparable material could most easily be obtained from this region. Seventeen anatomical traits of this structure were quantitatively studied. In the polyploid series, as in previous results, there was progressive increase in size of the structure and its constituent cells, but not always in the proportion expected. The cortex was relatively large in the haploid, and relatively small in the $3n$ and $4n$ mutants, the smaller cortex being due to fewer cells. These facts, and others from the heteroploid series, lead to the conclusion that cell size and cell number are independently controlled.

There were certain exceptions to the increasing cell size in the polyploid series. The pericycle fibres remain of the same size, perhaps because they are frequently found to be multinucleate. The leaves increase in thickness, due to increase in cell size and elongation of the palisade cells, those of the tetraploid having at least twelve times the volume of those in the haploid. Similarly the petiole in cross-section is about sixteen times as large in the tetraploid as in the haploid, the same applying generally to the cells, which therefore show a geometric rather than an arithmetic ratio of increase.

In the heteroploid series, all having 25 chromosomes, the anatomical differences were equally marked and were due to the genic constitution of the extra chromosome. Certain of the primaries, such as 'spinach', were even larger than the tetraploid, this being due almost entirely to larger cell size. Different elements of the anatomy show considerable independence in their response to the presence of specific chromosomes. The conception of genic balance applies very well to some of the secondaries in comparison with their primaries, but this is by no means always the case, and various attempts are made to explain aberrant results. Curious facts which emerge are that the starch grains, especially in the secondaries, may have a very large or very small mean size, and that while the style of the flower has two vascular bundles in the $2n$, $3n$ and $4n$ forms, in the haploid it always has five or six.

* The Comparative Anatomy of Extra-Chromosomal Types in *Datura stramonium*. By Edmund W. Sinnott, Helen Houghtaling and Albert F. Blakeslee. (Publication No. 451.) Pp. iii+50+19 plates. (Washington, D.C.: Carnegie Institution, 1934.)

University and Educational Intelligence

CAMBRIDGE.—Prof. R. H. Tawney, of the University of London, has been appointed Alfred Marshall lecturer for 1934–35.

Dr. T. S. Hele has been appointed assessor to the Regius professor of physic.

Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. Dominion and Colonial exhibitions are also offered to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. Further information can be obtained from the Senior Tutor, and applications should reach him by July 1, 1935.

MANCHESTER.—In connexion with the meeting of the Chemical Society to be held in the University on November 9 and 10, a reunion dinner of past and present members of the Department of Chemistry has been arranged; arrangements are in the hands of Drs. G. N. Burkhardt and C. E. H. Bawn of the Chemistry Department. A party of a hundred fellows of the Chemical Society will visit the Shirley Institute of the British Cotton Industry Research Association on November 9.

The following resignations and appointments have been announced this session:—Mr. F. W. Priestley has been appointed lecturer in veterinary bacteriology in succession to Mr. C. A. McGaughey, resigned. Dr.

R. W. Fairbrother has been appointed lecturer in bacteriology, and has vacated the assistant directorship of the Routine Section of the Department of Bacteriology and Preventive Medicine, to which Dr. J. C. Kerrin has been appointed. Mr. D. T. Robinson has been appointed assistant lecturer in bacteriology, and Messrs. I. A. Cathie and James Dawson demonstrators in pathology.

OXFORD.—The preamble of a statute designed to promote the more effective co-operation between Council and Congregation has passed the latter body without opposition.

Congregation has empowered the professor of zoology and comparative anatomy to continue, under the title of "Bureau of Animal Population", the provision made in his department for research into the ecology of wild mammals and for the co-ordination of data obtained from published sources and from field observers.

Dr. R. T. Gunther, the newly appointed reader in the history of science, delivered his inaugural lecture on October 25. He lamented the disappearance of many of the original instruments used by the pioneers of scientific research, as, for example, the air-pump of Boyle and Hooke; in many cases the actual instruments were more needed than even the records. In paying a tribute to the memory of Daubeny, he mentioned that among those who attended Daubeny's lectures were Sir John Bennet Lawes, Pusey, Mark Pattison, Ruskin and Acland.

AMERICAN education is about to receive a powerful impulse towards co-operative unification through the agency of the American Council on Education. This body, founded in 1918 with the object of organising co-operative effort in relation to problems of higher education, is now extending its activities to include the entire educational field. This development was announced at the Council's annual meeting at Washington on May 18, a summary account of which was published in *School and Society* of May 26. It was made possible by grants from a number of educational foundations: the General Education (Rockefeller) Board, 300,000 dollars; Julius Rosenwald Fund, 20,000 dollars; Carnegie Corporation, 20,000 dollars; Josiah Macy Junior Foundation, 12,000 dollars. In a report entitled "Integration", the Council's director, Dr. C. R. Mann, traces the steps by which it was arrived at. In a significant passage, the report declares: "We in America have kept the development and control of schools independent of political government . . . agencies created by the people to help them achieve their aspirations. In other countries schools are agencies created by government for such uses as government may choose to make of them". It is to provide the leadership needed for the perpetuation of this American system in the face of the manifold pressures of the rapidly changing social economy of to-day that the Council is undertaking such a radical enlargement of the scope of its work, and it is significant that the Council has elected as its new director, in succession to Dr. Mann, Dr. George F. Zook, who has resigned his post as United States Commissioner of Education. Dr. Zook has declared that the influence which led him to resign was the conviction that the Council, on its new basis of activity, seemed to present "a wonderful opportunity for service in formulating fundamental policies in education now so needed".

Science News a Century Ago

Gas Lighting at the Royal Institution

In 1834 the lecture room and adjacent parts of the Royal Institution were lighted by oil gas supplied by the Portable Gas Company. The compressed gas was delivered regularly to the Institution in metal containers, which were connected up to the pipe system. It will be remembered that in 1825 Faraday had separated the new compound bicarburet of hydrogen (benzene) by distillation of the condensed oil gas liquor which collected in the vessels used by the Company.

On November 3, 1834, Prof. Faraday reported to the Managers that, owing to the dissolution of the Portable Gas Company, new arrangements must be made for the lighting of the Institution. It was resolved to use coal gas. A few weeks later the Managers were informed that the new supply had been laid on to the building, the pipes and fittings used for oil gas had been adapted for the coal gas, and the system found to give a satisfactory and sufficient light without further change.

Aurora Borealis of November 3, 1834

In the *Memoirs of the Literary and Philosophical Society of Manchester* (6, Ser. 2, 1842) a paper, originally communicated by John Dalton, is printed (though long delayed in issue), referring to an aurora borealis of date November 3, 1834. Dalton reports that "in the evening I observed a horizontal light very conspicuous in the magnetic north; it continued without much change for two or three hours. A little before eight o'clock (true mean time), I was informed by two of my pupils that a fine arch to the south was observable; on looking I beheld a beautiful and brilliant arch crossing the magnetic meridian at right angles; its summit was 10° + to the south of the zenith, about 4 to 5 degrees broad, and extending from about 20 degrees altitude east to 20 degrees west. The appearance of an auroral arch such as was presented . . . is a rare phenomenon. I do not remember to have seen more than one before, and that was nearly forty-two years since. I believe no modern meteorologist has expressed a doubt that this arch-like appearance in the sky is only a modification of the more common appearance of the Aurora Borealis. I have for the last forty years considered both arches and beams to be constituted of magnetic matter, and in ordinary circumstances invisible; but when a disturbance of the electric fluid takes place in the upper regions these beams, etc., serve to convey the electric fluid from one place to another to restore the equilibrium, which occasions the luminous appearances."

Celestial Phenomenon seen at Liverpool

On November 7, the *Times* published a letter from a correspondent, "J. B.", and also an extract from the *Liverpool Courier*, relating to an interesting spectacle seen at Liverpool on November 3. The account in the paper said that "on Monday evening, about 8 o'clock, a singular luminous appearance was seen in the heavens commencing near the western horizon and after extending through the meridian of the heavens, finally losing itself near the brilliant planet Jupiter . . . It presented the aspect of a beauteous transparent zone of light, of near equal width, from six to seven degrees. . . . The stars

were distinctly visible through its filmy structure, and here and there a thin vapoury cloud crossed it at right angles. . . . Whether this splendid heavenly phenomenon should be ranked among the meteoric, nebulous or electrical class we cannot pretend to say". In discussing the occurrence, "J. B." referred to a somewhat similar phenomenon seen in 1812 and said, "The conclusion I then drew respecting phenomena of this kind, was simply this, that the line of steady light which extended across the heavens . . . was produced or liberated by two gentle breezes or currents of wind meeting each other which by acting mechanically upon each other, liberated that meteoric light or energy of the atmosphere with which it had become highly charged at this period".

Prof. J. L. R. Agassiz on Fishes

In the *Proceedings of the Geological Society* of 1834 is mentioned Prof. J. L. R. Agassiz's paper "On a New Classification of Fishes, and on the Geological Distribution of Fossil Fishes" delivered at the evening session on November 5. After comparing recent fishes with fossil fishes, Agassiz said he had arrived at a classification differing considerably from the various arrangements previously adopted by naturalists; "and by attentive examination of scales, fishes may be divided into more natural orders than had hitherto been adopted". In this manner he adopted four orders which bore some relations to the divisions of Artedi and Cuvier, namely, the Placoidians, which comprised the cartilaginous fishes of Cuvier, excepting the sturgeon; the Ganoides, about fifty extinct genera and including Plectognaths, Syngnaths and Acipensers; thirdly, the Ctenoidians, which are the Acanthopterygians of Cuvier and Artedi, excepting those with smooth scales, and with the addition of the Pleuronectes; fourthly, the Cycloidians, which were principally the Malacopterygians.

The number of species of fishes then known was estimated by Agassiz to be about 8,000, some three-quarters of which belonged to the Cycloidians and Ctenoidians, the presence of which had not then been discovered in the formations below the chalk. Agassiz said he did not know a single species of fossil fish found successively in two formations and he had examined more than 600 fossils on the Continent and 250 new species found in English collections. One third of the species in the London clay, the *calcairegrossier* of Paris, and at Monte Bolca, he added, belong to genera which existed no longer.

Zoological Gardens, Regent's Park

On November 8, 1834, the *Times* announced that "Yesterday morning the keepers belonging to the Zoological Gardens, in Regent's Park, commenced removing the numerous and valuable collection of birds and animals of tender habits into habitations adapted purposely for them during the winter season, which are heated in a peculiar manner. The arrangement of the various animals for inspection by visitors is admirably suited. The extremely cleanly manner in which all animals are kept is particularly creditable to the keepers. . . . During the winter some extensive improvements and additions to the gardens will be made; and they will then have to boast of being one of the most attractive and delightful promenades of the nobility and gentry in or near the metropolis".

Societies and Academies

PARIS

Academy of Sciences, October 1 (*C.R.*, **199**, 621–648). PAUL LÉVY: The asymptotic properties of sums of linked contingent variables. M. GHERMANESCO: The theorem of Picard. DIMITRI RIABOUCHINSKY: Some new remarks on the hydraulic analogy of the movements of a compressible fluid. JACQUES VALENSI: Aerial helices: photography of the trajectories. Study of the secondary vortices. RAYMOND AMIOT: The adsorption by carbon of binary mixtures in aqueous solution. The mixtures studied all included phenol, with either saccharose, mannite, erythrite or glycerol. MIROSLAV ROMANOWSKI: The attainment of a 50 per cent hygrometric state round an Otto Wolff standard resistance of lacquered wire, exposed to variations due to inequalities of atmospheric moisture. A standard hygrometric condition for the resistance coils is obtained with solutions of sulphuric acid of density 1·33. The International Bureau has adopted this method, proposed by the Physikalisch-technische Reichanstalt, in preference to using a hermetically sealed container. ANDRÉ CHRÉTIEN and PIERRE LAURENT: The existence of a frequent type of iodine complex in organic solution. An application of measurements of the dielectric capacity to solutions of iodine in organic solvents. It is shown that the iodine – pyridine complex contains one molecule of iodine to two molecules of pyridine. Similar complex compounds were found for other bases. RAYMOND ROHMER: The hydrates of cobaltous sulphate. C. E. BRAZIER, I. MASEK and R. GUILHEN: The influence of the transparency of the atmosphere on the results furnished by the comparison of two pyrheliometers. LÉON LAUNOY: The action of cystine on the toxicity of antimony.

LENINGRAD

Academy of Sciences (*C.R.*, **3**, No. 1). I. VINOGRADOV: Some new problems of the theory of numbers. N. MUSCHELISHVILI: A new general method for the solution of fundamental problems of the theory of elasticity in two dimensions. N. BYSTROV: An approximate solution of partial differential equations with three independent variables. P. S. NOVIKOV: Contribution to the theory of the relativistic continuum. S. ARCYBYSHEV: Penetration of copper into rock-salt by electrolysis and diffusion. V. SHPAKOVSKY: Velocity of the propagation of sou[illegible] in carbon dioxide near the critical state. N. I[illegible]NECOV-UGAMSKIJ: Temperature inversion and '[illegible]rd waves' in Middle Asia. W. SADIKOV, A. SHOSHIN, K. STARUCHINA and M. LIVSHITZ: Origin of carbon disulphide during the boiling of chicken meat. N. BROMLEY and V. ORECHOVITCH: Proteolysis in regenerating tissues. The autolysis of normal and regenerating tissues. I. KABAKOV and I. RYVKIN: Electrocardiographic studies on twins. KOLBANOVSKIJ and MIRENOVA: A comparative evaluation of methods for the development of combinative functions in pre-school children. Experiments with twin controls. V. SLODKEVITCH: The stratigraphy of the tertiary deposits of the western coast of Kamchatka. A. P. SEMENOV-TIAN-SHANSKIJ: A new genus of the sub-family *Pamphiliinæ* (Hymenoptera, Pamphiliidæ). A. SVETOVIDOV: The correlation between the character of food and the number of pyloric cæca in fishes.

MELBOURNE

Royal Society of Victoria, August 9. DAVID E. THOMAS: The Muckleford fault in the Strangways area, Guildford. This fault was earlier postulated by Messrs. Harris and Thomas as a north and south fault separating beds of Lancefieldian age to the west from those of Darriwilian to the east. Excavations by the Guildford Plateau Mining Co. exposed the fault locally, and it is here studied in detail. Lists of graptolites are given for each horizon of the faulted areas. It is here shown that the Lower Ordovician rocks have at least 4,000 ft. of beds missing on the western side, that the overlying Tertiary alluvial wash is displaced nearly 100 ft., and that the covering basalt has been shifted only 50 ft., thus showing at least three movements along this fault line, the last movement being very recent. Comparative notes are also given on other late Tertiary faults affecting alluvial workings in Victoria.

ROME

Royal National Academy of the Lincei, June 1. F. SEVERI: The rational involutions on a surface as an equivalence series: preliminary properties (1). Q. MAJORANA: The propagation of light reflected from a movable mirror *in vacuo*. L. LOMBARDI and E. BOTTANI: Can the distribution of the continuous current in a homogeneous conductor vary under the influence of a constant magnetic field? (1) Weber's work on this subject (1933) is discussed and experiments designed to check it are outlined. M. GORTANI: Succession of graptolite fauna in the neighbourhood of Goni, Sardinia. From the observations made, it seems possible to subdivide the graptoliferous series into palæontological zones of stratigraphic value, corresponding with those typical of the British region. O. CHISINI: A theorem of the existence of multiple planes (2). J. REY PASTOR: Multiple cumulants. E. BORTOLOTTI: General views on Vitali's calculus and its extensions (1). In this, and a second note, to appear later, it is shown that the two types or cases, termed by Vitali the general and the special case, may be combined into a single, more general one. L. CAMPEDELLI: Computation of the invariant of Zeuthen and Segre for an algebraic surface. A. MASOTTI: Dynamic actions exerted by a translatory-circulatory current on a hypocycloidal profile with n cuspids. G. AGAMENNONE: The hourly frequency of Italian earthquakes. The records of the past seventeen years furnish no evidence indicating that Italian earthquakes are not distributed uniformly throughout the twenty-four hours. This conclusion is in direct contradiction to the view, previously expressed, that earthquakes in Italy are appreciably more frequent during the night than during the day. S. FRANCHETTI: The phenomenon of fusion in relation to a new equation of state and to the lattice structure of solids (2). L. SONA: An observation regarding the propagation of electromagnetic waves. M. STRADA: Crystalline structure of thallium cyanide. X-ray examination of thallous cyanide by the powder method indicates a cubic structure of body-centred type. If the cyanogen group is regarded as a single entity, the unit cell would contain a single molecule, the side of the cell being 3·82 A. If, however, the cyanogen ion is considered as composed of two elements occupying distinct, although neighbouring positions in the lattice, the unit cell will contain eight molecules and have a side of 7·64 A.; the powder method does not fix exactly the symmetry of the carbon and nitrogen atoms and their positions in the lattice. The apparent radius of the cyanogen ion is 1·81 A. A. CAVINATO: The use of the prism for determining the principal refractive indices of crystals (2). The theoretical considerations previously outlined are applied to the case of an exceptionally clear crystal of sulphur. M. CURZI: A serious infection of peaches by *Phytophthora*. T. PERRI: Growth of the crystalline in anurid amphibia (experiments on *Bufo viridis*, *B. vulgaris*, and *Rana esculenta*) (1). R. SAVELLI: Microchemical observations on certain endocellular secretory formations.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 403–459, July 15, 1934). E. B. FRED and P. W. WILSON: On photosynthesis and free nitrogen assimilation by leguminous plants. In an atmosphere enriched in carbon dioxide (from 0·03 to 0·1 per cent), increased photosynthesis is accompanied by increased nitrogen fixation. Excessive photosynthesis depresses nitrogen fixation; thus shading is beneficial if plants have excessive carbohydrate. The association of high carbohydrate with increased number of root nodules was shown by varying the percentage of nitrogen and oxygen in the atmosphere. Addition of nitrate-nitrogen is accompanied by decrease in size and number of nodules, due probably to the fact that the carbohydrate level is reduced through synthesis of protein. Carbohydrate synthesis is normally rarely sufficient for maximum development of nodules. LINCOLN CONSTANCE: A preliminary revision of the perennial species of *Eriophyllum*. Only five species and eleven varieties are retained. H. C. SHERMAN and H. L. CAMPBELL: Observations upon growth from the viewpoint of statistical interpretation. Data from white rats show a close approximation to the symmetrical distribution generally assumed in statistical work. ANDREW DINGWALL and H. T. BEANS: A spectrographic study of the occurrence of chromium and molybdenum in carcinoma of the human breast. With one exception, sixty specimens examined contained chromium or molybdenum but not both. Details of the technique are given. BORIS EPHRUSSI: The absence of autonomy in the development of the effects of certain deficiencies in *Drosophila melanogaster*. CHESTER STOCK: New Creodonta from the Sespe Upper Eocene, California. GERALD B. HUFF: A note on Cremona transformations. G. A. MILLER: Distinct groups whose subgroups are simply isomorphic. EGBERTUS R. VAN KAMPEN: Locally compact Abelian groups. RICHARD C. TOLMAN: (1) Suggestions as to the energy-momentum principle in a non-conservative mechanics. (2) Suggestions as to metric in a non-conservative mechanics. M. J. BUERGER: The temperature-structure-composition behaviour of certain crystals. A theoretical discussion introducing a new notation to express crystal structure. B. KROPP and W. J. CROZIER: The production of the crustacean chromatophore activator. Extract of *Palæmonetes* eye-stalks from light-adapted animals produces chromatophore contraction (and also depresses growth when applied in agar to lupin root tips; compare auxin). Similar extract from dark-adapted animals produces a much smaller effect. It is suggested that the chromatophore activator is not entirely dependent on eye-stalk substance. S. S.

STEVENS: The attributes of tones. Two tones of different frequency are presented alternately, and the energy of one is altered until the two sound of equal pitch, volume or density. Equal volume requires increased intensity and equal density requires decreased intensity of the higher tone. Increased intensity, with constant frequency, causes drop in pitch with low tones and rise in pitch with high tones, 3,100–3,300 cycles remaining constant for all intensities. There are thus four types of response in the ear.

Forthcoming Events

[*Lectures marked with an asterisk are open to the public.*]

Sunday, November 4

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. Burton: "Protective Disguise among Animals".*

Monday, November 5

UNIVERSITY OF LEEDS, at 5.15.—Prof. Hans Driesch: "The Relations between Science and Philosophy".*

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.30.—Dr. S. G. Brade-Birks: "The Relation of Pedology to Agriculture" (succeeding lectures on November 7 and 9).*

Tuesday, November 6

KING'S COLLEGE, LONDON, at 5.30.—Sir Murdock MacDonald: "Estimation of Flow and Storage. Dams and Reservoirs".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Richard Redmayne: Presidential Address.

Wednesday, November 7

CHADWICK PUBLIC LECTURE, at 8.15—(at the Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1).—Dr. Margaret Fishenden: "Health and Indoor Climate".*

ROYAL SOCIETY OF ARTS, at 8.30.—J. A. Milne: "Arts and Commerce Promoted" (Inaugural Meeting).

Friday, November 9

CHADWICK PUBLIC LECTURE, at 7.30—(at the Technical College, Huddersfield).—Dr. Matthew B. Ray: "Fifty Years of Public Health Progress".*

ROYAL INSTITUTION, at 9.—Dr. Franklin Kidd: "The Respiration of Fruits".

Official Publications Received

GREAT BRITAIN AND IRELAND

Technical Publications of the International Tin Research and Development Council. Series A, No. 12: A Rapid Test of Thickness of Tin Coatings on Steel. By Dr. S. G. Clarke. Pp. 6. (London: International Tin Research and Development Council.)

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Twenty-first Year), 1933. Pp. 268+14 plates. (East Malling: East Malling Research Station.) Free to Associate Members; to non-Members, 4*s*.

Proceedings of the Linnean Society of London, Session 1933–34. Part 3, including Presidential Address by Prof. F. E. Weiss: On the Northward Extension of the Mediterranean Flora. Pp. 89–140. (London: Linnean Society.) 1*s*. 6*d*.

Report of Delegates of the United Kingdom of the 27th Meeting of the International Council for the Exploration of the Sea, held in Copenhagen from June 4th–11th, 1934. Pp. 3. (London: Ministry of Agriculture and Fisheries.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1933—March 31, 1934. Pp. 7. (Sidmouth.)

Mines Department. Thirteenth Annual Report of the Secretary for Mines for the Year ended 31st December 1933, and the Twenty-sixth Annual Report of H.M. Chief Inspector of Mines for the same Period, with a Statistical Appendix to both Reports. Pp. xxiv+236. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

OTHER COUNTRIES

The Institute for Science of Labour, Kurasiki, Japan. Report No. 24: Reports of the Research Station for Agricultural Labour of the Institute for Science of Labour, Kurasiki, No. 1: Organization and Function of the Research Station for Agricultural Labour. By Gitô Teruoka. Pp. ii+22. 50 sen. Annual Report of the Director of the Institute for Science of Labour for 1933. Pp. ii+29. 60 sen. (Kurasiki.)

A Survey of the Air Pollution Problem of the City of Scranton and Lackawanna County. Conducted by H. B. Meller and Logan B. Sisson. Pp. 43+3 plates. (Pittsburgh: Mellon Institute of Industrial Research.)

Sveriges Geologiska Undersökning. Årsberättelse för år 1933. Pp. 9. 0.50 kr. Ser. C, No. 380: Agrogeologiska undersökningar vid Svalöv. Av Gunnar Ekström. Pp. 115+4 plates. 5.00 kr. Ser. C, No. 381: En kvartär Stromatolitkalksten från Bohuslän. Av A. H. Westergård. Pp. 48+13 plates. 2.00 kr. (Stockholm.)

Annual Report for the Year 1933 of the South African Institute for Medical Research, Johannesburg. Pp. 91+2 plates. (Johannesburg.)

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 41: Early Life History of the California Sardine (*Sardina cœrulea*), with Special Reference to Distribution of Eggs and Larvæ. By Eugene C. Scofield. Pp. 48. Fish Bulletin No. 42: Maturity of the California Sardine (*Sardina cœrulea*) determined by Ova Diameter Measurements. By Frances N. Clark. (Contribution No. 119 from the California State Fisheries Laboratory.) Pp. 49. (Terminal Island, Calif.: California State Fisheries Laboratory.)

U.S. Department of Agriculture. Miscellaneous Publication No. 188: Macrolepidoptera and their Parasites reared from Field Collections in the Northeastern Part of the United States. By J. V. Schaffner, Jr., and C. L. Griswold. Pp. 160. (Washington, D.C.: Government Printing Office.) 15 cents.

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1934. Pp. 17. (Wellington, N.Z.: Government Printer.) 9*d*.

India: Meteorological Department: Scientific Notes. Vol. 5, No. 56: A Preliminary Study of a Tornado at Peshawar. By Flt.-Lieut. R. G. Veryard. Pp. 109–116+14 plates. 2 rupees; 3*s*. 6*d*. Vol. 5, No. 57: Humidity Records obtained at Agra with Hair Elements and with Wet and Dry Elements in a Dines' Meteorograph. By S. P. Venkiteshwaran. Pp. 117–123+1 plate. 7 annas; 9*d*. Vol. 5, No. 59: A Statistical Study of the Maximum Temperatures at Poona. By Dr. R. J. Kalamkar. Pp. 133–139+2 plates. 6 annas; 8*d*. (Delhi: Manager of Publications.)

Annalen v.d. Bosscha-Sterrenwacht, Lembang (Java). Vol. 4, Miscellaneous Papers, No. 7: A Study of the Systems of Satellites from the Standpoint of the Disc-Theory of the Origin of the Planetary System. By H. P. Berlage, Jr. Pp. 79–94. (Lembang.)

Koninklijk Nederlandsch Meteorologisch Instituut, No. 102. Mededeelingen en Verhandelingen, 34b: Het klimaat van Nederland. Door Dr. C. Braak. A (vervolg): Neerslag. Gedeelte 2: Nieuwe bewerking der tabellen van No. 15. (The Climate of the Netherlands. A (continued): Precipitation. Part 2: Revision of the Tables of No. 15.) Pp. 53. ('s Gravenhage: Rijksuitgeverij.) 0.60 fl.

Bulletin of the American Museum of Natural History. Vol. 67, Article 7: Contributions to the Geology of Northern Mongolia. Abstracted from the original Russian and annotated by Radcliffe H. Beckwith. Pp. 311–352. (New York City.)

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 2: List of Publications on Indian Entomology, 1931. (Compiled by the Imperial Entomologist, Pusa.) Pp. ii+27. 8 annas; 10*d*. Miscellaneous Bulletin No. 3: List of Publications on Indian Entomology, 1932. (Compiled by the Imperial Entomologist and the Offg. Imperial Entomologist, Pusa.) Pp. ii+36. 12 annas; 1*s*. 3*d* (Delhi: Manager of Publications.)

The Indian Forest Records. Vol. 20, Part 10: Sur quelques Longicornes des Indes (Cerambycidæ, Col.) Par N. N. Plavilstshikov. Pp. ii+6. (Delhi: Manager of Publications.) 3 annas; 4*d*.

Ministère de l'Agriculture: Direction des Eaux et du Génie rural. Études glaciologiques, 1920–1930. Par P. Mougin. Tome 7. Pp. vii+306+76 plates. (Paris: Imprimerie Nationale.)

Cornell University Agricultural Experiment Station. Bulletin 596: Interrelationships of Daily Prices and Supply in the New York Egg Market. By Karl Vogt. Pp. 50. Bulletin 602: Studies on Cold Storage of Vegetables. By H. Platenius, F. S. Jamison and H. C. Thompson. Pp. 24. Bulletin 605: An Economic Study of Grape Farms in Eastern United States. Part 1: Production. By G. P. Scoville. Pp. 50. Bulletin 607: Mobility of Rural Families. 1: Changes in Residence and in Occupation of Rural Husbands and Wives in Genesee County, New York. By W. A. Anderson. Pp. 32. Bulletin 608: A Study of Rural Community Development in Waterville, New York. By W. G. Mather, Jr., T. H. Townsend and Dwight Sanderson. Pp. 39. Bulletin 609: Soils in relation to Fruit Growing in New York. Part 5: The Vineyard Soils of the Westfield Area, Chautauqua County. By Joseph Oskamp. Pp. 18. Memoir 157: Studies on Powdery Mildew of Cereals. By Alberto Graf-Marin. Pp. 48. Memoir 158: Bottom Rot of Lettuce. By G. R. Townsend. Pp. 46. Memoir 159: A Comparative Study of the Green-Fluorescent Bacterial Plant Pathogens. By Feliciano M. Clara. Pp. 36. Memoir 160: Methods used in an Economic Study of Land Utilization in Tompkins County, New York, and in other Similar Studies in New York. By A. B. Lewis. Pp. 57. Memoir 161: Physiological and Chemical Changes in Carrots during Growth and Storage. By Hans Platenius. Pp. 18. Memoir 163: Vegetative and Reproductive Responses associated with Fruit Development in the Cucumber. By John P. McCollum. Pp. 27. (Ithaca, N.Y.)

CATALOGUES

A General Catalogue of Literature and Books on Miscellaneous Subjects, together with a Selection from the Library of the late Walter Leaf. (Catalogue No. 576.) Pp. 80. (London: Francis Edwards, Ltd.)

Accessories for Radiology. (Publication No. H/34.) Pp. 40. (London: Newton and Wright, Ltd.)

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No. 3393 Vol. 134

CONTENTS

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Economic Planning and Agricultural Production

SOCIETY, said Karl Marx, is a kind of organism on the growth of which conscious efforts can exercise little effect. That this is not the common view to-day is shown by the wealth of thought that is being devoted to 'planning', with the object of preventing the recurrence of economic crises and of securing, eventually, 'abundance for all'. Political and economic planning is now engaging the attention not only of economists and politicians, but also of those numerous professional men who usually ignore economists, as being too inhuman in their science, and politicians, as being all too human in their practice.

Most of the world's present economic and political troubles appear to have followed from man's failure to control his instincts of acquisition and pugnacity—'smash and grab' not being confined to the modern gangster ; and so we find that the proposed ameliorative measures relate mainly to the reorganisation of our productive, distributive and monetary systems, and to projects for keeping the peace.

Science in the service of man, aided by capitalism mainly in the service of the few, has done wonders for production ; but it has yet to solve the problems of exchange and distribution. From the point of view of the requirements of civilised man, maldistribution in Nature appears to be the rule rather than the exception, for not only are most useful minerals and plants very unequally distributed, but they are also often located in places difficult of access and exploitation. Valuable minerals are mostly found deep down in the earth ; the enormous amount of gold in sea-water is present in such dilute concentration, as Haber found, that it cannot be economically extracted ; and the upper air is not exactly the ideal location for the ozone required by modern industry and sanitation. Science and invention have, however, overcome many of these obstacles ; new instruments, machines and processes have been devised for locating and extracting valuable minerals ; the plant-breeder has provided economic plants that will grow in regions remote from their natural habitats ; and engineers have so revolutionised transport that both natural and artificial products can now be conveyed expeditiously and economically to the uttermost parts of the earth.

In spite of all such achievements, however,

man has signally failed to effect anything like an equal—and some would say a fair—distribution of the world's wealth, either among nations or individuals ; hence the spirit of evil in its hydra-headed shapes of want, fear, envy and discontent continues to stalk through the world, poisoning the well-springs of human happiness. If the world were ruled by reason, there is no doubt that every developed country would abjure war, would concentrate on producing those commodities for which it is best suited by its natural wealth, geographical position and the capabilities of its inhabitants, and would exchange them freely for commodities best produced abroad. How far and how fast the world has of late been departing from these ideals are well known ; less well appreciated are the implications for Great Britain. Once the premier exporter of manufactured goods and the greatest international 'shopkeeper', and paying for imports of food and raw materials by exports and services, with a good margin to spare, Great Britain is now being forced into a policy of national self-sufficiency ; and foremost among the problems now awaiting solution is that of food supplies : Can we afford to continue importing foodstuffs to the extent of about a million sterling a day ? And if not, what changes are necessary in our agricultural economy ? To this problem Sir Daniel Hall made a notable contribution in the address on the planning of agricultural production which he gave to the Agricultural Section of the British Association at Aberdeen.

The competition set up by intensive nationalism, according to Sir Daniel Hall, has destroyed the economic position of the British farmer, so that the nation has had to abandon free trade and to adopt protection. At the same time, internal competition alone, in which imports play but a small part, may be equally destructive of agricultural stability, checking enterprise and that development of production which the nation needs. This is the case for a planned agriculture. The various marketing boards can, by virtue of their monopoly, direct production along the lines that are most economic and best suited to the requirements of the consumer, but neither protection nor subsidies will suffice to bring about the required intensity of production ; farmers, in consideration of measures giving them adequate returns, must submit to a certain amount of control ; and an advisory body, acting behind the administration (and apparently having no relation to the Agricultural Research Council), should be appointed to advise upon the guiding principles of the nation's agricultural policy and upon their application.

Sir Daniel Hall thinks that we could increase our production of home-grown food from about 38 per cent of our total requirements, the present figure, to about 60 per cent, within a generation, and that, in general, we should concentrate our efforts on products that employ labour, demand skill, and are costly to transport. Live stock products, fruit and vegetables come within this category, whilst cereals and sugar, being more cheaply produced abroad, should be mainly imported. In this way Sir Daniel ranged himself on the side of the 'Up-Horn' school in the perennial controversy whether 'corn' or 'horn' should predominate in our agricultural economy. This school of thought maintains that our agricultural land is best suited by Nature for growing grass and its derivatives, beef, mutton, milk and other dairy produce ; that arable crops like wheat and sugar can be grown with greater security from adverse climatic factors, and more economically, in foreign parts than in Britain ; that home-grown flour is not liked by our millers and the bread made from it is not to the popular taste ; and that cheap corn is a fundamental requirement of a flourishing live stock industry. Our people require fresh food, whether milk, meat, eggs, fruit or vegetables, and this can best be grown at home.

The corn-dominant view is that England grows some of the best wheat in the world and with yields that are higher than those in most other countries. Thanks to mechanisation, production costs bid fair to fall to a level comparable with those in the great wheat-growing lands. Satisfactory 'hard' wheat can be grown in England, for example, Yeoman II, although perhaps not enough of it to meet all our needs. Wheat has always played an essential part in our cropping systems, and in time of blockade, as in 1917–18, its large-scale cultivation is imperative ; in a future war there may not be time to plough up more than three million acres of grassland to grow cereals for human consumption, as we had to do in the last. Beef, mutton and lamb, are, and probably always will be, produced far more cheaply in Argentina and Australasia, and butter in Denmark and New Zealand, than in Britain ; and the production of greatly increased quantities of fresh vegetables, fruit, milk and eggs is as feasible under an 'up-corn' policy as under an 'up-horn' policy. Moreover, increased beef production would necessitate

increased importation of feeding-stuffs, and so adversely affect the balance of trade. There is no foundation in fact for the contention that imported chilled or frozen meat is less nutritious than home-killed meat.

Loving compromise as we English do, it should not be impossible to frame a policy that would go far to satisfy the chief demands of these two opposing schools. It might, for example, be possible to combine an 'up-horn' with an 'up-corn' policy by extending our present area of cultivated land, for example, by improving upland pastures in the way Prof. Stapledon is now showing us, by reclaiming submarginal land (heaths, moorlands and estuarine lands) and improving much marginal land by draining and liming; and, generally, by improving all fertile land by the increased use of fertilisers. It has been estimated by one of the active planning groups in London that about sixty per cent of our total food requirements could be obtained by such measures, which would include the conversion of sufficient very poor land to provide 2½ million acres of good land, the substitution of more wheat and barley, grown wherever possible under mechanised conditions, for some of the oats and roots now produced, and a greatly increased production of pig-meat, eggs, fruit and vegetables.

Prof. Scott Watson, in his presidential address to the Agricultural Section of the British Association, advocated a substantial reduction in the area now under oats, which, owing to the development of motor traffic and other causes, has been steadily declining for some time past. A scheme like the above would involve large capital expenditure from public funds; and so, indeed, would any drastic scheme, but capital expended on land reclamation and improvement would continue remunerative for many years to come. The State is already supporting agriculture, directly and indirectly, to the tune of more than £45 million yearly (the figure for 1933), and it is conceivable that some of this amount might be diverted into more directly productive channels. Moreover, we have been expending hundreds of millions of pounds on keeping the unemployed in idleness, and some of this large store of potential energy might be converted into work on the land.

In Sir Daniel Hall's opinion, the continuance of the State subsidy for sugar-beet is open to question. That subsidy has cost the country some £40 million since its inception in 1923, and is still costing more than £3 million a year. Although much may be said in favour of past policy—it has saved many arable farmers from bankruptcy, has given work to thousands of men during the campaign period in the winter months, has provided food for stock in the form of 'crowns' and 'pulp', and has ensured thorough cultivation and cleaning of the land upon which it is grown—Sir Daniel's contention that scientific research has so increased the yield of sugar from the sugar-cane that beet can no longer compete with it, is undeniable. In certain Continental countries, the cultivation of sugar-beet has been subsidised for many years, largely because the alcohol made from the sugar brings in a very high revenue to the State. We make practically no industrial alcohol from home-grown materials in Great Britain, but if we did there would be something to say on the other side.

Worthy of consideration in any scheme of agricultural production would be the establishment of industries like the manufacture of potato-starch and dextrine, and of strawboard from cereal straws, most of our requirements of which we now import; and there is good reason for believing that these industries could be instituted in such a way as to make them self-supporting within a short period of years.

The problems involved in planning agricultural production are thus seen to be both numerous and complex. Whatever the actual outcome may be, it is reasonably certain that if we abstain from our usual practice of 'muddling through', and adopt some definite policy, its nature will be determined as much by considerations of world and Empire relationships and home economics, as by the dictates of agricultural science. But economic planning, as Prof. Scott Watson points out, must not be regarded as a substitute for scientific education and research. Science will and must make its voice heard, and if the advisory body asked for by Sir Daniel Hall is appointed, it is to be hoped that he and other men of scientific outlook and attainments will be invited to take part in its counsels. Fortunately, British agriculture is now directed by a Minister who is alive to the value of scientific knowledge and method; but it will need all his ability and that of his colleagues and advisers to come to conclusions concerning the future of economic nationalism, and of international affairs, before any attempt can be made to map out a long term policy of home food production in Great Britain.

Man's Line of Ascent

Man's Place among the Anthropoids: Three Lectures on the Evolution of Man from the Lower Vertebrates. By Prof. William King Gregory. Pp. vi+119+4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 6*s*. net.

IN "Man's Place among the Anthropoids" Prof. W. K. Gregory, of the American Museum of Natural History, has made a further contribution to a discussion which was initiated by Prof. F. Wood Jones in a lecture given in 1918 at King's College, London, on "The Problem of Man's Ancestry". In this lecture the belief held by most anatomists, namely, that man has sprung from the line of anthropoid apes, was attacked and rejected. The issue which was then raised by Prof. Wood Jones really extends far beyond the limits of anatomical inquiry; it concerns those who are seeking to unravel the evolution of human culture quite as much as those who are inquiring into the evolution of man's body.

Among students of human culture, we find those who believe that separate peoples may make the same invention or arrive at similar practices quite independently; we find others who maintain with even greater emphasis that such similarities never arise independently but are always traceable to borrowing—either from one another or from a common source.

We find anatomists divided into the same two schools. The orthodox view—the diffusionist theory—that similarity of structure implies similarity of descent—is upheld by Prof. W. K. Gregory. Prof. Wood Jones champions the cause of independent or parallel evolution. Prof. Gregory traces man to an anthropoidal origin; Prof. Wood Jones carries his lineage back to the tarsioids—the ancients of the monkey world. The orthodox Prof. Gregory accepts the anthropoid ape as the nearest of man's living relatives. The heterodox Prof. Wood Jones, while admitting the structural resemblances of anthropoids to man, rejects their kinship on the ground that such resemblances are really of the nature of anatomical mimicry. He regards the sole surviving tarsioid—the nocturnal *Tarsius spectrum* of the Bornean jungle—as having the best claim to human kinship.

It may help onlookers to understand the difficulties which students of man's evolution have to face if we continue to compare the methods used by students of human culture with those employed by morphologists in search of man's origin.

In accounting for the origin of new things or for the modification of the old, the student of culture has an easy task; the human brain has creative powers which answers to all postulates. Where is the 'creative brain' which serves the needs of those who are seeking to unravel the history of the human body? Nowhere in his last book does Prof. Gregory specify the machinery which brings about the structural adaptations of the body of ape and man. He assures his readers he is not a Lamarckian, and yet on p. 8 we find him making the following statement about the early evolution of the shoulder girdle:

> "When the stout paddles came to push against the ground instead of the water, new stresses and strains were initiated in the shoulder-girdle, so it is not surprising that under Natural Selection or some other potent influence, the cleithrum, which was the largest dermal element, became smaller, while the scapulocoracoid became larger."

This extract has certainly a Lamarckian flavour; the evolution of the shoulder girdle is ascribed to the "stresses and strains" which fall on it. In reality, Prof. Gregory presumes that the living flesh of the shoulder girdle is possessed of the virtues which are inherent in living nerve tissues—the power of profiting from experience.

Prof. Wood Jones is more explicit than Dr. Gregory as to the manner in which structural modifications are brought about. In "Man's Place among the Mammals" (1929)—to which Prof. Gregory's book is a reply—he makes his position clear thus (p. 31):

> "That correlation, in the sense of harmonious change in the structure and function of a whole system of parts and organs, involves in its explanation some factor far more plastic, far more subtle, than any chance variation or mutation, has always been apparent to a certain section of students of Nature. . . . Since we have every reason to believe that these things are the outcome of the interaction of the environment and the animal, it seems not impossible that identical correlated adaptations might be manifested in different animals which having no intimate relation with each other, are subjected to the same range of environmental conditions".

Prof. Wood Jones is a confessed Lamarckian and here ascribes to the living body an evolutionary power of altering its structure, function and appearance according to demands made on it by its environment. It is thus possible for him to believe that the vast number of anatomical characters which man and the anthropoid apes have in common do not represent an inheritance from a common ancestor, as is Prof. Gregory's opinion, but are separate acquisitions forced on the bodies of man and ape by similarity of environment.

The position adopted by Prof. Wood Jones is almost identical with that taken up by the school

of cultural anthropologists which regards the human brain as being constituted alike in all races and therefore reacting to difficulties by finding the same modes of overcoming them at all times and in all places. Prof. Gregory, on the other hand, while by no means denying the possibility of independent or parallel evolution, yet regards it as exceptional and accepts similarity of structure as evidence of community of origin. In so doing he has the support of the vast majority of anatomists. Until we have obtained a more accurate knowledge of the means by which the structural adaptation of the body and brain is brought about and the rules which regulate the transmission of such adaptation or modifications from one generation to the next, we cannot be certain that our interpretation of anatomical evidence is right.

The differences between Prof. Gregory and Prof. Wood Jones are not so great as the similarities which unite them. Both believe that man's body has been evolved and that the means which have raised it from the lowest to the highest position among primate forms, are placed not outside the body but are inherent properties of its living flesh. Prof. Wood Jones's theory makes the greater demand on the powers of evolution ; he presumes that humanity has arisen from a very lowly animal which differed from man both inwardly and outwardly, whereas Prof. Gregory seeks to bring him from a form which had already climbed to a high position in the primate tree and assumed both in body and in brain striking resemblance to man's estate.

Prof. Gregory claims that all recent discoveries of fossil man and of fossil anthropoid favour the anthropoid theory of man's origin and are against the Tarsian hypothesis advocated by Prof. Wood Jones. In making this claim Prof. Gregory has the support of most anatomists.

Chemistry in Space

Stereochemie : eine Zusammenfassung der Ergebnisse, Grundlagen und Probleme. Herausgegeben von K. Freudenberg. Lief. 4. Pp. 481–638. 18 gold marks. Lief. 5. Pp. 639–798. 18 gold marks. Lief. 6. Pp. 799–958. 18 gold marks. Lief. 7. Pp. 959–1116. 18 gold marks. Lief. 8. Pp. 1117–1276. 18 gold marks. Lief. 9. Pp. 1277–1376. 10.80 gold marks. Lief. 10 (Schlusslieferung). Pp. xvi+1377–1509. 18 gold marks. (Leipzig und Wien : Franz Deuticke, 1932–33.)

PART I of Freudenberg's "Stereochemie" has already been reviewed somewhat fully in these columns (NATURE, April 22, 1933, p. 563), and a briefer notice must suffice to record the completion of Parts II and III and the index. In reviewing Part I, it was pointed out that the work of Pasteur, the real founder of stereochemistry, was not sufficiently appreciated, and, in particular, that his discriminating use of the term dissymmetry had been ignored, for example, by using the term '*anisotropy factor*' as a measure of the optical activity associated with an absorption band in a *dissymmetrically isotropic* medium. A similar neglect of fundamental definitions is shown at the beginning of Part II, where it is stated that "In stereochemistry the term 'asymmetric' does not mean an absence of all symmetry but only of mirror-image symmetry". This is an unfortunate distortion, since *asymmetry* can only be defined accurately as implying an absence of *all* symmetry ; and the absence of mirror-image symmetry is precisely the phenomenon which Pasteur defined as dissymmetry. This confusion was at one period just as prevalent in English writings on stereochemistry as it now appears to be in Germany. Indeed, on one occasion, the reviewer was accused in print of having himself invented the term which formed the title of Pasteur's lectures to the Société Chimique de Paris in 1860, and which is actually carved on a panel of his mausoleum in the Institut Pasteur in Paris ; but it is to be hoped that so good a chemist as Freudenberg will in the next edition of his "Stereochemie" take the opportunity of correcting these errors in elementary geometry.

In the limited space available it is impossible to do justice to the painstaking work of the contributors to the thousand pages now under review. As an example of this thoroughness, it may be noted that Ebel in discussing the "Resolution of Racemates" not only enumerates eleven cases in which attempts have been made to effect this resolution by picking out enantiomorphous crystals of the *d* and *l* forms, but also attempts in eleven pages of tables to summarise the multitudinous cases in which this resolution has been effected by the use of ferments or of optically active acids, bases, etc.

Freudenberg's own contribution on "Configuration of Optically Active Compounds" begins with a lament that "No one has yet had the good fortune to be able to determine the arrangement in space of the substituents of an asymmetric carbon atom". It is therefore only possible to compare the "relative configurations" of related substances. This can be done most conclusively by carrying out substitutions in which the linkages to the asymmetric carbon are not disturbed, since in all other substitutions the risk of Walden inversions renders the results entirely untrustworthy.

By methods of this kind Freudenberg has himself converted dextro-rotatory tartaric acid into

dextro-rotatory malic acid (of opposite sign to the naturally occurring acid) and thence into lævo-rotatory glyceric acid and lævo-rotatory lactic acid (again of opposite sign to natural sarcolactic acid). Much confusion has arisen from the fact that configuratively related compounds such as these often differ in the sign of their optical rotations. Thus it has become customary to describe lævulose (or lævo-rotatory fructose) as *d*-fructose, because it has the same configuration as ordinary dextrose or *d*-glucose. Almost every optically active compound is therefore liable to have its nomenclature reversed, whenever a claim can be made that its configuration has been established relatively to that of some other related compound. Freudenberg proposes to get over this difficulty by writing his four acids as

$d(+)$ Tartaric acid.	$d(-)$ Glyceric acid.
$d(+)$ Malic acid.	$d(-)$ Lactic acid.

In this system, sarcolactic acid, which has been known for half a century as *d*-lactic acid, is formulated as $l(+)$ lactic acid; but readers who are not specialists in stereochemistry may easily be misled by the alteration from d to l; and even the insertion of a $+$ or $-$ sign may be ambiguous when the sign of the rotation is liable to be reversed by changes of concentration or of wave-length, as it is in all acids of the type cited above.

An important section of Freudenberg's article is devoted to the "Determination of Configuration with the help of Optical Activity". As a worker in the field of optical activity, the reviewer cannot share the faith of organic chemists in the validity of deductions made on this basis. Thus, even when it can be shown that analogous effects are produced in related compounds by changes of wave-length, temperature, solvent and concentration, or of substitution, he believes that the configurations of the compounds in question may nevertheless be reversed, as they certainly *must* be reversed, on passing from a methyl-ethyl to a propyl-ethyl carbinol of similar sign. Sooner or later, however, the problem of predicting the sign and magnitude of the rotation of an asymmetric carbon atom from the nature and configuration of its substituents, which has already been attempted by de Mallemann, will certainly be solved, and the problem of relative configurations will then become subsidiary to the more fundamental problem of deducing the absolute configurations of optically active compounds of either sign.

The "Physical Properties of Stereoisomeric Olefines" are discussed by Wassermann in an article of eighty pages, and R. Kuhn contributes a short article of eight pages on isomeric change in the same series of compounds. The latter author also describes, under the ambiguous title of "Molecular Asymmetry", the optical activity of spiro-compounds, and of compounds in which molecular dissymmetry is produced by the impedance of free rotation. On the other hand, the impedance of free rotation in derivatives of ethane, for example, by the mutual influence of dipoles, figures largely in an article by Ebel, in which the posture assumed by saturated chains and rings is discussed.

Part II also includes an important article by Dr. Wagner-Jauregg on "Molecular Rearrangement in Optically Active Compounds", in which the phenomena of racemisation and of the Walden inversion are discussed; and it concludes with an article by Dr. Hans Beckmann, in which the biological behaviour of stereoisomers is described.

Part III includes an article of two hundred pages by Meisenheimer on the stereochemistry of nitrogen and of its homologues; Ziegler contributes an article on the stereochemistry of the homologues of carbon and of oxygen; and finally Pfeiffer contributes an article of 178 pages on "Complex Compounds". Several of the later sections of the book include supplementary paragraphs, so that they have been kept up to date during the necessary interval before publication. The book is therefore an exceptionally complete review of the subject and will be widely consulted by those who can secure access to so expensive a work.

[Added August 1, 1934.] Since this review was written, a solution of the problem of the absolute configuration of optically active molecules has been announced in a paper by S. F. Boys in the *Proceedings of the Royal Society* (A, 144, 655). In particular, the absolute configuration of lævo-rotatory amyl alcohol

$$\begin{matrix} C_2H_5 \\ CH_3 \end{matrix} > CH.CH_2.OH.$$

is illustrated by means of a figure (*loc. cit.*, p. 686) which shows that, when viewed from the radical $-CH_2.OH$, the other three radicals attached to the asymmetric carbon atom are in clockwise order in the sequence C_2H_5, CH_3, H.

A tentative solution has also been given by Kuhn and Bein (*Zeitschr. physikal. Chem.*, B, 24, 335; 1934) in the more complex case of a spiro-compound of the formula

$$\begin{matrix} HO.CO \\ CH_3 \end{matrix} > C < \begin{matrix} O.CH_2 \\ O.CH_2 \end{matrix} > C < \begin{matrix} CH_2.O \\ CH_2.O \end{matrix} > C < \begin{matrix} CH_3 \\ CO.OH \end{matrix}$$

which contains no asymmetric carbon atom, but was resolved by Böeseken in 1928. The same authors have also discussed (*Zeitschr. anorg.*

Chem., 216, 321; 1934) the absolute configuration of co-ordination compounds of the type

$$K_3[Co.3C_2O_4] \text{ and } [Co.3C_2H_4(NH_2)_2]Br_3,$$

where the complex ion has (like quartz) the symmetry of a three-bladed propeller. The phenomena are here extremely complicated, since most of these salts are strongly coloured, and give rise to very complex curves of rotatory dispersion; but a figure is given (*loc. cit.*, p. 339) which shows the configuration assigned to the forms of the two cobaltic salts, which are dextrorotatory in the red, but lævorotatory for sodium light. This figure is not easy to interpret without a model; but it can be translated as the equivalent of a diagram of a three-bladed propeller with the blades set as in a right-handed screw, so that if rotated in a clockwise direction it would move away from the observer. T. M. LOWRY.

Bird Exhibition and Study

Autobiography of a Bird-Lover. By Frank M. Chapman. Pp. xiii+420+59 plates. (New York and London: D. Appleton-Century Co., Inc., 1933.) 15*s*.

FRANK M. CHAPMAN in his autobiography tells of the cultivation of friendship with Nature for many years. He started in a bank, but in 1886 threw up a most financially promising career for the relative poverty of employment in the ornithological division of the American Museum at New York. His story is that of the rise of his sub-department from the dull and dusty crowded and unattractive cases of perched birds, thousands of such mounted 'specimens' with no study collections in reserve, to the finest and most attractive department in any science museum. His job was uphill work, entering, arranging and classifying collections, his soul saved by the employment of all his holidays and spare hours in the study of birds in the wild. Gradually the policy of the Museum evolved and determined itself, so that Chapman's life is a long story of explorations and Nature study, with intervals for the consolidation of his spoils.

At first, the author's attention was confined to the United States, but it soon passed to Mexico, Cuba, Trinidad and the West Indies region. Then come stories of the study of individual birds in all their surroundings, these as well as the birds to be carried home. Explorations in Colombia and Chile were concerned with zonal distributions and there were odd visits to the Old World and two years with the Red Cross. It is noticeable that the technique of such explorations is to find a favourable place in which to settle and study, and to drain it dry.

With all this, Chapman was a familiar figure in societies and at meetings, taking part in their discussions. There are tales of and shrewd observations on many naturalists, including statesmen such as Roosevelt and Grey who sought relief from their rather exacting occupations in the study of Nature. The former was his friend, so that it must have been pleasing to him in 1928 to receive the Roosevelt medal "for distinguished service", and he was clearly man-of-the-world enough to like being conjoined with C. E. Hughes and Lindberg. Assuredly all ornithologists will read so pleasant and so well-presented a book.

Ornithology was happy in having such a man as an executive officer; for he was a great "creative innovator in methods of exhibition". He made the studies upon which was built up that great hall of habitat groups of birds, the most astonishing and greatest exhibition of any natural history museum. Even as to any single one of the long series of exhibits, at first each devoted to a single species of birds, there is nothing in Great Britain comparable in any way.

The birds were studied in their own homes, and the attempt is made to show their natural attitudes and their growth from the nest; they have around them their own natural surroundings, vegetation, rock and earth, and the background is landscape suggested by the actual spot from which the birds came. The whole effect is one of space and freedom, and this is especially noticeable in the larger and more ambitious faunal groups, which are culled from many regions and environments. The picture of the pampas group is beautiful, with a dozen or so species of birds on its waters and between its reeds with flights overhead, recalling the word pictures of Hudson to whom it is dedicated. Finally, there is the great hall, often a place for social functions, with its huge dome, blue sky and clouds traversed by flights of birds, and, suspended to the same by invisible wires, realistically mounted birds, all soaring overhead. The lighting is realistic and we look up to see ducks, geese, pelicans, the albatross and condor all there fading into the distant sky. Fuertes had a genius for the artistic selection of the scenery and Jaques is an artist (not a scene painter), while Chapman in choosing the flamingo, spoonbill and other species, that must vanish as man's world grows, has preserved in the surrounds he gives them a record of priceless value for all times.

We have seen some of these habitat groups in New York and were surprised at the visitors, young and old, that thronged to see them, an everlasting source of enjoyment to the parents and a holiday visit for the children as keenly anticipated as a visit to the cinema or a play. As exhibits they are beautiful in themselves and

they are an educative study of great importance such as we trust we may one day see in the British Museum. The collection of species is valuable, but the undue accumulation of skins and dried bones, useful enough for the study of variation and evolution, may be carried too far in museums, which, if intended for the public, should exist as backgrounds for the study of animals in wild Nature, their adaptation and fitting in to their natural environments. The world requires the widest range of interests, and millions to-day have learnt to love Nature. The museum which stands still and does not recognise this is doomed, while the one that evolves with the advances of the times will surely not lack the necessary support.

Short Notices

An Elementary Treatise on Pure Mathematics. By N. R. Culmore Dockeray. (Bell's Mathematical Series.) Pp. xiv+566. (London: G. Bell and Sons, Ltd., 1934.) 16*s.* net.

THE development of modern geometry from its fundamental Euclidean basis marked the beginning of a new epoch in the teaching of school mathematics, for it led slowly to the removal of those artificial divisions which formerly encompassed arithmetic, algebra and geometry. Such a natural process, however, was not destined to stop at these subjects, and, in these days of advanced courses and scholarship classes, it is gradually, though surely, permeating analysis, which has too long regarded algebra, trigonometry and the calculus as distinct parts.

In the volume under review, a very welcome attempt has been made to sweep away these divisions, and analysis is here treated as a unified whole. A large part of the text has necessarily been devoted to the never ending subject of convergence, which is fundamental to the rigour demanded by modern mathematics. Limits, continuity and differentiation are dealt with quite early, and are followed by an interesting and exhaustive chapter on the exponential theorem and the logarithmic series. Next comes more convergence of series, this time, of complex terms, out of which is logically developed the expansions of the circular functions, both in series and in products. Chap. xi is devoted to a lucid discussion of Taylor's theorem, which is followed by a very practical chapter on the applications of the calculus to curves and curve-tracing. The treatment here is much fuller than usual and deals with the real difficulties that often confront a student. The book closes with more convergence and the expansions of trigonometrical functions as infinite products.

As the book has been written essentially for scholarship candidates and first year university students, no attempt has been made to treat analysis as a rational development of the continuum of real numbers, and the omission to deal with irrational numbers is due to the fact that this part of the subject has already been treated so well by G. H. Hardy in his "Pure Mathematics".

One wonders whether the course is not a little overbalanced on the side of theoretical convergence, in spite of its fundamental importance.

The text is clearly written and well printed, and a large number of exercises provided for practice. These are stated to be fairly simple, but whether the student will think so is another matter, although in some cases valuable hints for solution are given.

Teachers should welcome such an admirable textbook as this, for it is undoubtedly a real contribution to school mathematics. F. G. W. B.

Das Tierreich: eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Gegründet von der Deutschen Zoologischen Gesellschaft. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin. Herausgegeben von F. E. Schulze und W. Kükenthal, fortgesetzt von K. Heider, seit 1927 von R. Hesse. (1) Lief. 57: *Pseudoscorpionidea I., Subord. Chthoniinea et Neobisiinea.* Bearbeitet von Dr. Max Beier. Pp. xx+258. 40 gold marks. (2) Lief. 58: *Pseudoscorpionidea II., Subord. C. Cheliferinea.* Bearbeitet von Dr. Max Beier. Pp. xxi+294. 48·75 gold marks. (3) Lief. 60: *Acarina; Tydeidae, Ereynetidae.* Bearbeitet von Dr. Sig Thor. Pp. xi+84. 12 gold marks. (Berlin und Leipzig: Walter de Gruyter und Co., 1932–1933.)

(1 and 2) THE sharply delimited group of false scorpions, which includes small tracheate arachnids 1–6 mm. in length, has attracted a considerable number of students, and the known species now number approximately 800, which are referred in this work to about 160 genera and 14 families. Dr. Beier gives a detailed account (19 pp.) of the external features of the order and a brief summary of the biology. He then subdivides the order into the three sub-orders noted in the title, the constituent families, genera and species of which are carefully defined and their discrimination aided by keys. 571 line drawings of diagnostic features are added, and the whole forms a critical and competent systematic survey.

(3) This part deals with two families of primitive, prostigmatic, terrestrial mites from a tenth to a third (rarely a half) of a millimetre in length, our knowledge of which has been built up chiefly during the last thirty or forty years. The earliest notice of the Ereynetidae was that by Réaumur, who in 1710 recorded and figured their occurrence on the region of the pulmonary opening of *Helix pomatia* and in the terrestrial streptoneuran *Ericia* (*Cyclostoma*) *elegans*, and added drawings of the dorsal and ventral aspects of this "insecte des limaçons" now known as *Riccardoella limacum*. Dr. Sig Thor has dealt skilfully with these difficult families, in which he recognises 17 genera and about 85 valid species, the systematic characters of which are shown in 102 figures.

(1) *The Journal of the Institute of Metals.* Edited by G. Shaw Scott. Vol. 53: Metallurgical Abstracts and Index to Volumes 51, 52 and 53 of the Journal. Pp. v+887. (London: Institute of Metals, 1933.) Not sold separately; £4 net (inclusive of two preceding "Proceedings" vols.).

(2) *The Journal of the Institute of Metals.* Edited by G. Shaw Scott. Vol. 54. Pp. 326+22 plates. (London: Institute of Metals, 1934.) 31*s.* 6*d.* net.

(1) THIS volume comprises the metallurgical abstracts which have already been circulated to members of the Institute of Metals during 1933 in the monthly *Journal*. The whole range of metallurgical science and practice has been covered in the usual comprehensive manner. Besides the structure and properties of metals and alloys and the metal working processes, a wide variety of topics, from the electron theory of metals to the uses of aluminium paint, are covered in abstract form in this volume. An imposing list of abstractors' names is given, but a list of the periodicals abstracted would be much more useful.

(2) The thirteen papers presented at the March meeting of the Institute, together with Dr. H. Moore's presidential address and Prof. E. K. Rideal's May lecture on "Gases and Metal Surfaces" are now available as vol. 54 of the *Journal*. Prof. Rideal gives a lucid survey of recent advances in the physicochemical study of the adsorption of gases by metals, in the course of which it is possible to discern several pointers to future methods of study of lattice structure. One of the most interesting of the papers is that by Prof. Portevin and Dr. Bastien on "Castability of Ternary Alloys", a subject of great practical importance in foundry practice which is slowly but steadily being investigated on sound physicochemical lines. Research on the phenomenon of fatigue is represented by a communication from the National Physical Laboratory dealing with the influence of the intercrystalline boundary on fatigue characteristics. Other topics include the constitution of copper-iron-silicon alloys, magnesium-nickel alloys, and silver-beryllium alloys. The volume concludes with a full appreciation by Prof. Hanson of the late Dr. Rosenhain, a past-president of the Institute and the greatest modern exponent of physical metallurgy.

L. H. B.

Die Flechten: eine Einführung in ihre allgemeine Kenntnis. Auf Grund neuerer Forschungen und kritisch dargestellt von Prof. Dr. Friedrich Tobler. Pp. v+84. (Jena: Gustav Fischer, 1934.) 5.50 gold marks.

IN 1931, Prof. F. Tobler delivered at the invitation of the University of London three lectures on lichens. The publication under review is the outcome of these lectures. In it Prof. Tobler has endeavoured to put forward a well-founded, general and physiological conception of the group of lichens. He wanted to show and make clear what he and his school considered that a lichen was and what a lichen could do. He mentions four important characteristics of the lichen. The algæ present in the form of gonidia must be more or less intimately connected with fungal hyphæ, to insure free exchange of food-material. A morphological differentiation might be expected separating the lichen from even allied fungi. The physiological success of such a symbiosis is, of course, also necessary. Vegetative reproduction by such organs as soredia, for example, is an important feature in many species of lichens.

Prof. Tobler brings forward much new evidence in support of his view, that in the perfect lichen we have such a close union between alga and fungus, and such a balancing of physiological activities, that the resulting organism must be looked upon as a unity. He therefore disparages the use of the term consortium, as stressing too much the dual nature of the lichen. Prof. Tobler has written an interesting and useful pamphlet, though its appearance might be looked upon as symptomatic of modern views generally, rather than as creative of a quite new idea.

O. V. D.

Leçons de zoologie et biologie générale. Par Prof. Georges Bohn. (3): *Les invertébrés* (*Coelentérés et vers*). (Actualités scientifiques et industrielles, 133.) Pp. 102. (Paris: Hermann et Cie, 1934.) 15 francs.

IN a brief account of the coelenterates, sponges and worms, in which structure is subservient to biology and life-history, is a number of explanatory references of interest to the general reader. Prof. Bohn records that at the time of the battle of the Yser, soldiers who had bathed several times in the sea off Pas de Calais and had been stung by the large jelly fishes were gravely indisposed and some died. This serves as an introduction to a short account of anaphylaxy. The swarming of *Heteronereis* is graphically described and referred to as an impressive scene of life and death—the males circling round the females and rendering the sea-water milky by their discharged sperms, the sudden rupturing of the bodies of the females and the liberation of the eggs, which are immediately fertilised, while the bodies of the females fall to the bottom and die. Interesting examples of life-histories, especially of rotifers and of parasitic worms, are given and afford opportunity for reference to parthenogenesis, heterogony and neoteny (as in *Caryophyllæus*).

Life and Soul: Outlines of a Future Theoretical Physiology and of a Critical Philosophy. By Max Loewenthal. Pp. 291+4 plates. (London: George Allen and Unwin, Ltd., 1934.) 8*s.* 6*d.* net.

THIS book expounds an attractive hypothesis of the nature of life and soul, which, no doubt, will appeal to the common-sense of the reader. The author develops the notion of a material which is capable of utilising the waste heat of the universe, and of being formed, in other conditions of temperature, electrical potential and pressure, of other elements than those found on the world's surface. As his 'archiplasm' is not supposed, however, to be an object of direct apprehension, much of the author's hypothesis is bound to remain in the serene realm of speculation.

T. G.

Use and Origin of *Yerba Maté**

By CAPT. T. A. JOYCE, O.B.E.

INFUSIONS from vegetable products are common throughout the world, but the particular infusion with which this address deals is that procured from the leaves and shoots of the *Ilex paraguayensis*, a shrub indigenous to Paraguay and to southern Brazil. After a process of drying, aided by fire, hot water is poured on the broken or powdered leaf, and the infusion is imbibed through a tube of silver or of native bamboo. From the centre of its origin it spread rapidly, like all valuable food products, to the Argentine, Chile and Peru, and, especially since the War, when many South American contingents were engaged, it has become more familiar in Europe than formerly.

The particular virtue of the drink is that it contains little or no tannin, combines favourably with a meat diet, and can be repeatedly refreshed by hot water without deleterious effects. In South America, especially amongst the Gaucho class, it used to take the place of fruit and vegetables, for it is an antiscorbutic of considerable value. Thousands of tons are used in South America annually.

Mixed with cold water, it provides a very refreshing beverage, but the normal method of taking the drink is in the hot infusion. When lukewarm it is regarded as a violent aperient. Two appliances are used, the *maté*, a gourd or silver cup in which the decoction is prepared, and a tube, the *bombilla*, through which the infusion is drunk. The word for the receptacle (*maté*) became transferred to the leaf and the drink; both are now generally known under that name, especially in Europe.

The first mention of the drink in published literature occurs in a book by Nicolás Durán, a Jesuit missionary in Paraguay in the early seventeenth century. Durán travelled through the province of Guaira and visited the Jesuit missions at Villa Rica, San Xavier, Loreto and San Ignacio; all these regions were, at that time, centres of *yerba maté* preparation and of distribution.

Translated from the Latin, Durán writes as follows:

"The most severe labour to which the Indians are put consists in being sent by their masters to Maracaiu, to collect the foliage of certain trees growing in the mountains and forests. These trees, not unlike laurels, but of a brighter green, flourish especially in moist and swampy woods. The leaves, after being parched in a fire, are pounded in mortars, and, when reduced to dust, are packed in cases, and carried many miles on the backs of the Indians. On account of the unhealthiness of the climate, and the scarcity of food, which their poverty-stricken masters cannot provide, these unhappy Indians are forced to subsist on snakes, grubs and spiders. And so, worn out by contagious diseases and famine, they die. It is a pitiable picture, for, in return for their labour, all they receive when they return from this slavery is a beggarly two yards of cloth. Some even go home empty-handed, because the Spaniards themselves are extremely poor. The Spaniards sell the powder of this herb (which they call 'Herb' *par excellence*) to traders who come hither (Guaira), or rather exchange it for necessaries. And it often happens that 2,000 lbs. of this powder is given for a suit of common cloth, or 500 lbs. for a hat. Spaniards and Indians of both sexes drink this powder, mixed with hot water, once or twice daily, which proves a most efficacious emetic. So much are they slaves of this habit, that they will barter shirt, trousers or bedding for it. An instance is known where a woman stripped her hut of its roofing in order to buy this herb. They say too that their strength fails, and that they cannot live, if they are deprived of its use. The Indians take it at daybreak and at frequent intervals during the day. It has come to be such a vice in these provinces that all the inhabitants of the River Plate, Tucuman and Chile make use of it. So that in Potosí, and throughout Peru, 1 lb. of this herb is sold for four golden crowns. This herb makes men gluttons, slaves to their bellies, and renders them averse to work of any kind. And its efficacy appears to lie more in the imagination of him who uses it than its own inherent virtue."

By the middle of the seventeenth century, Nicolas del Techo (du Toict), who became Superior of the Province of Paraguay, as a Jesuit missionary, writes of the use of the drink as follows:

"In Paraguay, for a long time, sugar and cotton, both produced in small quantities, were the chief wealth, till the leaves of a certain tree, growing in marshy grounds, commonly called the Herb of Paraguay, began to be in esteem. These leaves they dry in the fire and reduce to powder; then, mixing with hot water, the Spaniards and Indians, both men and women, drink of it several times a day; and, vomiting it up with all they have eaten, they find it creates an appetite. Many things are reported concerning this powder or herb; for they say if you cannot sleep, it will compose you to it; if you are lethargick, it drives away sleep; if you are hungry it satisfies; if your meat does not digest, it causes an appetite; it

* Presidential address to Section H (Anthropology) of the British Association, delivered at Aberdeen on September 10.

refreshes after weariness and drives away melancholy and several diseases. Those who once use themselves to it cannot easily leave it, for they affirm, their strength leaves them when they want it and can't live long: and so great slaves are they to this slender diet, that they will almost sell themselves rather than want wherewithal to purchase it. The wiser sort (tho', moderately used, it strengthens and brings other advantages) will hardly ever make use of it; and, if immoderately used, it causes drunkenness and breeds distempers, as too much wine does. Yet this vice has not only overrun Paraguay, but Tucuman, Chile and Peru. And is near coming over into Europe; this Herb of Paraguay being valued amongst the precious commodities of America. At first the Spaniards were well pleas'd with their cotton garments and liquor made of honey. But afterwards, trade enhancing the value of this herb, covetousness and luxury encreas'd, to feed both which the Indians began to be enslav'd to make this powder. Labour made their numbers decrease, and that made the Spaniards poor again; to show us that very often the same methods we take to gather wealth serve to impoverish us."

The two quotations given above are couched in rather harsh terms in regard to the excessive use of the ilex; but the same could be written of tea, or any infusion, or of alcoholic drinks, if taken in excess. However, Southey, writing in 1817, avers that over-indulgence has been known to result in almost total mental aberration, lasting over many days; and the danger of serious infection, owing to the use of a common *bombilla*, which passes from lip to lip, is emphasised by many writers. Demersay adds that the constant imbibing of hot *maté*, alternating with draughts of cold water, is bad for the teeth, and suggests that the use of a silver *bombilla*, which can become unbearably hot, may cause cancer in the lip.

As regards the properties of the ilex, which have won for it so widespread a popularity, authorities are not quite in accord. Christy (1880) states that the leaf contains "the same active property as tea or coffee, in a proportion (nearly 2 per cent) intermediate between the two; a volatile oil; 16 per cent of an astringent principle; and about 10 per cent of a nutritious gluten, only a portion of which is dissolved in the infusion." He states further that the full benefit of the leaf is only obtained when it is chewed.

The "Handbook of Paraguay" (1894) gives the analysis as 0·45 caffeine, 20·88 caffeo-tannic acid, an aromatic oil, gluten and a proportion of theine. However, we may conclude that the action of the infusion would be that of a cardiac and a nutritive, while the relatively small proportion of tannin would render it more digestible than tea. It is, perhaps, a little strange that the earliest authors who record its use, Durán (1626–27), Leon Pinelo (1636) and del Techo (1649–72), quote it primarily as an emetic.

To leave aside for the moment the question of the actual discovery of the properties of *yerba maté*, the initial exploitation of the 'tea' was undoubtedly due to the Jesuit missionaries. The first Jesuit reservation was founded in 1609, the last in 1760, and the Jesuits were expelled in 1774. The missionaries encouraged the use of the leaf among their Indians, to whom it was served out with other rations; and Endlicher and Martius state that this was done to wean the natives from over-indulgence in fermented drinks. But there is no doubt that the revenues derived from the trade in the leaf became indispensable to these self-supporting communities, whose establishment is one of the most remarkable developments in the world's history. On the expulsion of the Jesuits, their mission houses and lands became Crown property, and the *maté* industry had become so prosperous that, in 1807, the profits derived from it were reckoned at £100,000 annually.

Long before this, in the seventeenth and eighteenth centuries, the leaf had become an article of trade to the western provinces of the Argentine, to Uruguay, Chile, Peru, Bolivia and Ecuador. The chief collecting region was the Maracayu district. Asunción was the outlying depot, whence the produce was sent by river to Santa Fé, on the Paraná, the chief depot for external trade. Frézier (1712–14) writes that the ordinary route was from Santa Fé to Jujuy in the Argentine by wagon and thence to Potosí in Bolivia by mule-back. Chile, according to Juan and Ulloa (1740–44), was supplied direct from Buenos Ayres, and passed supplies on to Peru.

The most vivid and detailed account of what had developed into a well-organised industry was given by the Robertsons in the first half of the nineteenth century. Then, the chief collecting regions, the *montes*, or woods where the ilex flourished, were near Villa Real, about one hundred and fifty miles up river from Asunción. The work of collecting was lucrative, but so arduous that it was usually performed by newcomers and men in debt. These concessionaires were financed or 'grub-staked' by merchants of Asunción, who expected repayment in the form of *yerba*.

Each concessionaire hired twenty to fifty workers, and the difficult journey through untracked forest to the ilex groves (*yerbales*) ended when a promising locality was reached; here, camping-ground was prepared for a stay of six months or so, with huts for the personnel and corrals for the mules and oxen. The *tatacua*, a

space some six feet square of hard-beaten earth, with a post at each corner, was made ready for the preliminary curing of the leaf, a simple process of scorching the masses of verdure over burning logs.

Nearby, the *barbacua* was prepared, an arch of boughs supported on trestles; upon this arch the ilex leaves, now readily separated from large twigs and boughs, were placed for the secondary drying. The fire built below the arch was carefully tended to prevent the leaves from burning, and to ensure complete drying; and, when the process was complete, the *barbacua* and the ashes of the fire were removed, the ground swept and beaten smooth, and the dried ilex leaves placed on it, and pounded with wooden mallets.

The powdered or broken leaf was then packed tightly into sacks made from freshly flayed bulls' hides (*serones*), sewn up and left to dry. Each *seron* weighed 200–220 lb. when dry. A similar process is employed to-day.

(*To be continued.*)

Ascorbic Acid (Vitamin C)

THE discussion on ascorbic acid (vitamin C) which was held in Section B (Chemistry) at the recent meeting of the British Association was, as the official title of the discussion indicated, mainly devoted to the chemical aspect of the subject. Perhaps the chief impression brought away from the meeting was of the astonishing advance made in our knowledge of vitamin C since Tillmans and Hirsch in 1932, after discovering that the vitamin could undergo a reversible oxidation without loss of potency, pointed out the great similarity between its properties and those of Szent-Györgyi's hexuronic acid (now known as ascorbic acid) and suggested that the latter substance might itself be the vitamin.

The speedy confirmation of this suggestion by Szent-Györgyi himself, followed by many other workers, led to an intensive study of the chemistry of ascorbic acid, which resulted in the synthesis of the compound (1933) dowered with the full antiscorbutic potency of the natural substance. As has so often happened, it has also led to the synthetic production of numerous substances of similar composition, none of which has so far been found in plants or animals, but some of which are possessed of substantial antiscorbutic power, in all cases up to the present considerably less than that of ascorbic acid itself. A new chapter in the study of the relations between physiological properties and chemical constitution has thus been opened and many interesting results have already been obtained.

Conflicting results were obtained by different investigators as to the constitution of ascorbic acid, but further experience has decided in favour of that worked out by Dr. E. L. Hirst and his colleagues at the University of Birmingham as against that of the Swiss workers Micheel and Kraft. Nevertheless, both formulæ served to inspire the successful synthesis of the acid, which was independently effected by the same method at Birmingham (Haworth and colleagues) and at Zurich (Reichstein and colleagues)—not the first occasion, as Dr. Reichstein remarked, on which synthetic studies, though based on incorrect suppositions, have turned out successfully.

The original synthesis from *l*-xylosone by way of the hydroxynitrile

$$CH_2.OH\ CH(OH).CH(OH).CO.CHO \longrightarrow$$
$$CH_2.OH.CH(OH)\ CH(OH).CO.C(OH).CN \longrightarrow$$
$$CH_2\ OH.CH(OH)\ CH\begin{cases} O - CO \\ \quad\quad\ | \\ C(OH){:}C(OH) \end{cases}$$

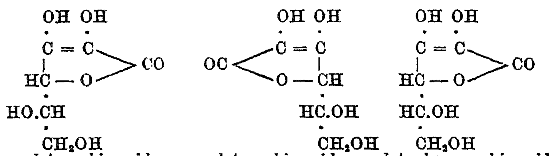
suffers from the disadvantage that the raw material of the synthesis is difficult to prepare in quantity. It is, however, a general method and can be applied to other osones, leading to the production of the corresponding 'ascorbic acids'. Among the results which followed rapidly on the synthesis of *l*-ascorbic acid were the preparation of *d*-ascorbic acid, from *d*-xylosone, and of the corresponding products from the arabinosones, *d*-arabo-ascorbic acid and *l*-arabo-ascorbic acid. Of these four isomerides, *l*-ascorbic acid has the full antiscorbutic potency of the natural acid; *d*-ascorbic acid is quite inactive, so far as it has been tested; *d*-arabo-ascorbic acid possesses about one twentieth of the activity of *l*-ascorbic acid and *l*-arabo-ascorbic acid is quite inactive. *l*-Rhamno-ascorbic acid, prepared from rhamnosone (Reichstein) has about one fifth of the activity of *l*-ascorbic acid, the highest value yet found in any analogue of the natural acid.

The osones of the hexoses yield the corresponding 'ascorbic acids' containing seven carbon atoms. The derivatives of *d*-glucosone and *d*-galactosone are inactive, whilst that of *l*-glucosone has a slight activity, about one fortieth of that of the natural acid.

The tentative conclusion drawn from the data so far available is that the antiscorbutic activity of the substance is, in the first instance, correlated with the configuration of the fourth carbon atom, which in *l*-ascorbic acid is the optically active carbon atom of the ring. If the configuration about this carbon atom is dextro, as in *l*-ascorbic acid, the substance possesses anti-

scorbutic power; if the configuration is laevo, the substance is inactive (Reichstein). Haworth has also directed attention to the fact that the formulæ of *l*-ascorbic acid and *d*-arabo-ascorbic acid are identical with respect to the stereochemical arrangement of groups attached to the ring and only differ by the reversal of one OH-group in the side chain. The remaining part of the molecule, however, has a considerable effect on the degree of antiscorbutic power of the substance, as is shown by the great difference between the two compounds just referred to in this respect, the potency of *d*-arabo-ascorbic acid being only one twentieth of that of *l*-ascorbic acid.

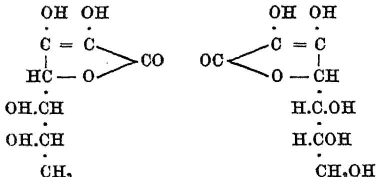
The following formulæ illustrate these points. It has been assumed that the constitution of the ring is the same in all these substances, although this has not yet been proved in each case.



l-Ascorbic acid from *l*-xylosone (active)

d-Ascorbic acid from *d*-xylosone (inactive)

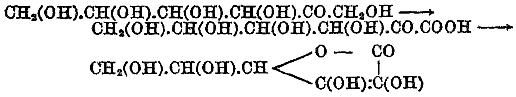
d-Arabo-ascorbic acid from *d*-arabinosone (active 1/20)



l-Rhamno-ascorbic acid from rhamnosone (active 1/5)

d-Gluco-ascorbic acid from *d*-glucosone (inactive)

An alternative mode of synthesis of compounds of this class has been found, again by both groups of workers, which has the advantage that the raw material is easier to prepare. This process consists in the oxidation of the β-ketoses to form β-ketonic acids, the osonic acids, which readily undergo isomerisation to the corresponding ascorbic acid derivatives. For example, in the case of sorbose, we have the following changes:



In addition to opening up a new method for the preparation of further members of the ascorbic acid series, this synthesis has provided a rapid and cheap method for the production of *l*-ascorbic acid. Glucose is reduced to sorbitol and the latter oxidised to sorbose by Bertrand's method, making use of the action of an appropriate oxidising bacterium. The sorbose is then oxidised directly by means of dilute nitric acid (Haworth) or, in the form of its di-acetone compound, by permanganate (Reichstein) and the product is isomerised by heating with water. So efficacious is the method that the synthetic acid is at present attainable at a cost less than that of sufficient oranges to contain the quantity purchased.

Turning now to the biological function of ascorbic acid, it is to be noted that the fundamental problem of the part which it plays in normal metabolism has not yet been solved. Szent-Györgyi attributes its physiological properties to its high reducing power and the reversible nature of its oxidation. Preliminary observations suggest that it may be a useful remedy in several diseases which have hitherto not been found amenable to medical treatment. Among these Szent-Györgyi mentions purpura hæmorrhagica, Werlhoff's disease, certain forms of hæmorrhagica nephritis and hæmophilia, pyorrhea, etc. Protection against disease appears to depend on the level of content of the vitamin in the organism, and the curative effects so far observed suggest that humanity is suffering more gravely from a lack of vitamin C than has hitherto been supposed.

Another interesting fact mentioned by Szent-Györgyi is the effect of the vitamin on pathological pigmentation. Whereas it has no effect on normal pigmentation, its administration is stated to cause the disappearance of the pathological pigmentation which accompanies certain diseases, such for example as Addison's disease.

Until the clinical evidence is available, these claims must be considered as being *sub judice*, but the suggestion that ascorbic acid is capable of producing such effects will arouse great interest and no doubt will lead to a thorough investigation of the subject, in the course of which it is to be expected that some light will be thrown on the part played by ascorbic acid in the normal metabolism both of plants and animals.

Szent-Györgyi also suggested that only animals living normally under tropical conditions require a supply of ascorbic acid from external sources. The animals of our temperate zone—the dog, the rat, the fowl, etc.—are capable of synthesising the vitamin, whereas the guinea pig and the monkey require a constant supply in their diet. Man belongs to the latter group, and the suggestion is made that this points to some tropical region as the birthplace of mankind.

It will be seen that great progress has been made in the study of vitamin C, and the plentiful supply of the pure material which is now assured justifies us in looking forward to further advances in the near future, which can scarcely fail to provide the clue to the metabolic function of this vitamin in particular and to add greatly to our knowledge of metabolism in general. A. H.

Obituary

Prof. O. V. Darbishire

Born at Conway in 1870, Otto Vernon Darbishire had the advantage of a varied education, passing his school years in Dresden and Florence and pursuing his university studies at Bangor, Oxford and Kiel. Thus he gained not only a wide outlook on life, but became also a good linguist—an inestimable advantage for a scientific worker. After graduating with honours in botany at Oxford, where he studied under Prof. Vines, he went to Kiel, and there took up first the study of Algæ, obtaining the Ph.D. degree. He then became assistant to Prof. Reinke and commenced his investigations into the structure and development of lichens, a study which he pursued throughout his life. He also turned his attention to the taxonomy of this group of plants, publishing an important monograph of the genus *Roccella* in the "Bibliotheca botanica" in 1899. By his researches and publications on lichens he became one of the leading authorities on this group of plants, and was entrusted with the determination of the lichens collected by the second Norwegian expedition of the *Fram* and also of those collected by the Swedish Antarctic expedition.

In 1898, Darbishire was appointed lecturer in botany in the University of Manchester, a post which he held until 1909 when he was appointed lecturer in the Armstrong College, Newcastle-on-Tyne. In 1911 he went to the University of Bristol, first as lecturer and head of the Department of Botany and afterwards in 1919 as the first holder of the newly established Melville Wills chair of botany. His duties in Manchester necessitated his specialising to some extent in plant physiology, and his wide interests led him to take an active part in the work of the Central Committee for the Survey and Study of British Vegetation, which afterwards developed into the British Ecological Society. Nevertheless, though his time was during the later part of his career fully occupied with heavy teaching and organising duties, he never lost his interest in lichens and even during the past few years he published several important contributions to lichenology in the *Annals of Botany*, in *Flora* and in the *Annales de Cryptogamie exotique*.

Darbishire was a good teacher and took an active personal interest in his students. While in Manchester, he undertook voluntarily for some years the instruction in botany of a class of small children, and the outcome of the experience so gained was the publication of a "Plant Book for Schools". He was equally successful with university students, and the botanical department at Bristol owes much to the energy with which he developed the botanical teaching in the University during the twenty-three years of his association with it. He took an active interest in other aspects of the students' life, acting as commanding officer of the Officers Training Corps during the War and for two years afterwards. Outside the University he interested himself in the work of the Bristol Naturalists' Society and in that of the South Western Naturalists' Union, of which he was the president.

A few years ago, Darbishire met with a serious cycling accident, which incapacitated him almost completely for some considerable time. Happily his recovery, though slow, was sure, and he completely regained his powers, so that he could again undertake both his teaching and his research work. He was no doubt looking forward to the opportunity after his retirement, which was due next year, to devote more time to the investigation of lichens, and we might have expected further important contributions to botanical science. But alas, it was not to be. Taken ill very suddenly, he died after an operation on October 11 at the age of sixty-four years, leaving a widow and two young sons.

F. E. W.

Miss E. A. Willmott

It is with great regret that we have to record the sudden passing of Ellen Willmott at Warley Place, Brentwood, on September 27 last, at the age of seventy-four years.

Scientific gardeners are rare in any age, and the good work accomplished by Ellen Willmott in scientific horticulture during her long life will be remembered and appreciated for centuries to come. From the scientific point of view, her most enduring work will probably be her magnificent monograph of the genus *Rosa*, to which she devoted the best years of her life and a considerable part of her private fortune. In many ways this monograph *de luxe* is unique, and nothing approaching it had appeared for nearly a century. It was in 1817 that Redouté first produced his beautiful folio plates of "Les Roses", but even that treasure pales in artistic and scientific significance before the accurate and life-like illustrations of Willmott's "Rosa". Such fidelity to Nature in a botanical work is extremely rare, and considerably increases its scientific value. In Alfred Parsons, Willmott discovered a scientific artist, and the careful reproduction of his drawings reflects the utmost credit on all concerned. Baker, who was responsible for the Latin diagnoses and bibliography, was a distinguished botanist who had made a special study of roses. The charming literary, historical and horticultural notes on each species were contributed by Willmott herself and were the result of many years' research and horticultural experience.

It is evident that the whole conception of the work, and the welding together of the artistic and scientific elements into a realistic whole with a universal appeal, were due entirely to the genius of Ellen Willmott, and her monograph on roses stands as a lasting monument to her artistic and scientific sensibilities.

C. C. Hurst.

News and Views

Medal Awards of the Royal Society

THE following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received the King's gracious approval: *Copley Medal* to Prof. J. S. Haldane in recognition of his discoveries in human physiology and of their application to medicine, mining, diving and engineering; *Rumford Medal* to Prof. W. J. de Haas for his researches on the properties of bodies at low temperatures, and, in particular, for his recent work on cooling by the use of adiabatic demagnetisation; *A Royal Medal* to Prof. S. Chapman for his researches in kinetic theory of gases, in terrestrial magnetism and in the phenomena of the upper atmosphere; *A Royal Medal* to Prof. E. D. Adrian for his work on the physiology of nerve and its application to the problems of sensation; *Davy Medal* to Prof. W. N. Haworth for his researches on the molecular structure of carbohydrates; *Darwin Medal* to Prof. A. C. Seward in recognition of his work as a palæobotanist; *Sylvester Medal* to Earl Russell for his distinguished work on the foundations of mathematics; *Hughes Medal* to Prof. K. M. G. Siegbahn in recognition of his work as a physicist and technician on long-wave X-rays.

Council of the Royal Society

THE following names have been put forward for election as officers and council of the Royal Society for the ensuing year: *President*, Sir Frederick Gowland Hopkins; *Treasurer*, Sir Henry Lyons; *Secretaries*, Sir Henry Dale and Sir Frank Smith; *Foreign Secretary*, Prof. A. C. Seward; *Other Members of Council:* Prof. E. D. Adrian, Dr. E. J. Butler, Dr. W. T. Calman, Mr. D. L. Chapman, Prof. A. W. Conway, Prof. W. H. Eccles, Prof. T. R. Elliott, Mr. P. P. Laidlaw, Sir Gerald Lenox-Conyngham, Prof. J. C. McLennan, Dr. F. H. A. Marshall, Sir Charles Martin, Prof. G. T. Morgan, Prof. R. Robison, Dr. Herbert H. Thomas, Prof. E. T. Whittaker.

A. P. Borodin (1834–77)

ALEXANDER PORFIREVIČ BORODIN, the distinguished Russian chemist who was born on November 12, 1834, was the natural son of Prince Guedeanov. At an early age he was attracted to music and is better known as a composer than as a man of science. He studied chemistry under Zinin at St. Petersburg (Leningrad), graduating in medicine in 1858. He had a brief career as an army doctor, and after being appointed as professor of chemistry, was sent abroad with Mendeléeff and others to study under Bunsen, Kekulé and Erlenmeyer in Germany and under Wurtz at Paris. Borodin also went to Italy with Mendeléeff and studied at Pisa. Before returning to St. Petersburg in 1862, to take up his duties as professor, he commenced a series of investigations on the condensation reactions of aldehydes and discovered aldol simultaneously with Wurtz. He prepared and studied numerous double inorganic fluorides and a few organic fluorides. Altogether Borodin published about twenty chemical papers, the last few dealing with the higher fatty acids. His leisure was mostly given to music and his musical friends (his wife, Katerina Sergeievna Protopova, was a pianist), but he found time to urge the claims of Russian women regarding education, and from 1872 he gave free lectures in chemistry for the St. Petersburg Women's Medical School, of which he was one of the founders. He died on February 16, 1877.

Sir Alfred Gilbert, R.A.

IN connexion with the death of Sir Alfred Gilbert, the sculptor, which occurred on November 4, at the age of eighty years, it is interesting to note that originally he contemplated adopting the medical profession as a career; early changed, however, for that of a sculptor. St. Bartholomew's Hospital Medical School recalls, with legitimate pride, that among medals attached to the foundation, one, instituted in 1897, was in honour of Sir William Lawrence (a colleague in his day of Abernethy), surgeon at St. Bartholomew's from 1824 until 1865, and president of the Royal College of Surgeons in 1846 and in 1855. The medal was designed and executed by Gilbert. Cast in gold and chased, and 2½ in. in diameter, it was exhibited at the Royal Academy in 1897, together with an enlargement in plaster of Paris. The gift is awarded annually in association with a valued senior studentship in medicine and surgery. The obverse depicts the head of Lawrence, not in profile, but within a sculptured circle, looking directly towards the spectator, an unusual medallic presentation. The reverse carries a beautiful composite design, also within a sculptured border; a youth in the centre has two draped females on either side personifying Wisdom and Science, and they whisper words of counsel, embodying a line from Homer. Sir William Lawrence, who was born in 1783 and died in 1867, is thus worthily commemorated through the art of Gilbert.

Research and Development Lectures

IN 1933 the British Science Guild established the Research and Development Lectures, with the special object of directing public attention to the importance of scientific research and of the utilisation of its results in the service of mankind. The first lecture of the series was given in May 1933 by Sir Harold Carpenter, on "Metals in the Service of Human Life and Industry". Early in 1934 the suggestion was made by Lord Melchett, president of the Guild, that the lectures should be given in the theatre of the Royal Institution, in which special equipment and facilities exist for the experiments and demonstrations it was desired to have. The proposal was accepted by the managers of the Royal Institution and arrangements were made by which the British Science Guild had the use of the lecture theatre on two occasions in May. On

May 2 Sir William Bragg lectured on "Refrigeration" and on May 30 Lord Rutherford on "Helium and other Rare Gases". These two lectures were attended by many members of both Houses of Parliament, and others engaged in public affairs, and at the first of them the Prime Minister presided.

THE success which has attended these lectures has encouraged the belief that the continuance of the series is desirable. The intention is to afford those concerned in the public affairs and industries of the country an opportunity of keeping themselves informed of scientific developments and of the progress of scientific research, particularly in its social and economic bearing and its applications to industry. The managers of the Royal Institution have agreed to co-operate with the council of the British Science Guild in the arrangement of a further programme of four lectures. The subjects have been chosen from four branches of science—electricity, acoustics, metallurgy and biology—in which there have been specially interesting developments in recent years. In each case, the lecturer will describe some notable scientific principle or discovery and trace its consequences down to the point at which the practical and industrial applications which have flowed from it have become matters of national or even wider significance. The following lectures, for the first of which the invitations have now been issued, will be on Wednesdays at 9 p.m.: Mr. C. C. Paterson, on "The Liberation of the Electron: Its Industrial Consequences" (Nov. 21); Dr. G. W. C. Kaye, on "Sound and Noise" (Dec. 12); Prof. C. H. Desch, on "The Microscope and the Metal Industries" (Feb. 6); Sir Frederick Keeble, on "The Fertility of the Earth" (March 6).

Developments in British Air Transport

THE recent air race to Melbourne has focused attention upon the possibilities of air transport to that particular part of the British Empire, and Sir Philip Sassoon, Under-Secretary for Air, has stated that the Air Ministry, the Post Office and Imperial Airways have been working for many months on plans for further development of commercial air transport. He emphasised the fact that this action on the part of the authorities was not in any way attendant upon the result of this race, but was the natural culmination of continuous investigation and methodical application of the improvements in the technique of aeronautics to air transport problems. He stated that he hoped to be able to announce within the next month or two, in conjunction with the Dominions and Colonies, plans that will result in the flying time between London and the Empire capitals being progressively and drastically reduced, and also that steps towards the desiderata of reasonably constant loads in both directions will be taken by further developing air mail traffic.

AIR mail traffic probably offers the simplest form of experiment in the system of carrying by relays of fast machines, the obvious solution to the problem, as the question of personal fatigue of the passengers does not affect the case. Having established optimum conditions for this class of traffic, it will be possible to investigate the variations in it necessary when dealing with the human element. This will possibly prove more expensive in the first instance, as it will call for the use of special mail-carrying aircraft, which will not be hampered, either in their design or their proportion of time in the air to time on the ground, by considerations of passengers' comfort. With this class of machine it should be possible rapidly to approach times of the order established during the recent race. The present system of designing for and operating with a mixed traffic of mails, goods and passengers, with the additional necessity of running the air line as a paying commercial proposition so far as is possible, always presents the vague and incalculable problem of the personal element of the passengers' requirements. This can only be solved by the relative slow method of short steps in introducing improvements with elimination of the unsatisfactory ones by trial and error.

England–Melbourne Air Race

THE official times now announced for the Centenary Air Race from England to Melbourne are: Scott and Black (D.H. Comet), 64 hr. 48 min. 49 sec.; Parmentier and Moll (Douglas D.C. 2), 76 hr. 38 min. 12 sec.; C. J. Melrose (D.H. Moth), 79 hr. 17 min. 50 sec.; Stodart and Stodart (Airspeed Courier), 79 hr. 32 min. 30 sec.; Macgregor and Walker (Miles Hawk), 82 hr. 43 min. 34 sec.; Hewett and Kay (D.H. Dragon), 85 hr. 42 min. 28 sec.; Hansen and Jensen (Desoutter), 87 hr. 45 min. 21 sec. Mr. C. W. A. Scott and Mr. T. Campbell Black have therefore been given the prize of £10,000 as winners of the speed race; they have also been awarded the British Silver Medal of the Royal Aeronautical Society for their flight.

Inland Water Survey

WRITING in reference to our leading article on "Inland Water Survey" in the issue of NATURE of October 27, Mr. Alan Chorlton, M.P., says that while generally supporting the project for the institution of a survey at an early date, he considers there are other factors which should be taken into account. To arrive at the total of the water supplies of Great Britain without proper relation to where they are likely to be called for would be, he fears, to create another break in the development of water supply in the country. He alludes to an air survey for the positioning of aerodromes and notes that town and country planning call for something to be done to bring the Ordnance Survey up to date. It seems to him that consideration should be given to the general interrelation of all these matters in order to ensure that they will ultimately be properly co-ordinated. "A water survey should, at least, be undertaken with relation to the areas the water is required for: that is, a combination of survey with the recommended allocation".

As regards water supply generally, Mr. Chorlton finds that a statutory central water authority is not

yet a form of administration which the majority of water undertakers would agree to. "A great deal of education is still required before they will come into line. At present, common action is made possible through regional advisory committees and joint committees. For this reason it has not seemed advisable at present to press the statutory side of any control. If it has to come, it will be later, and it will grow out of the development of the situation indicated, by the continued consideration of those concerned in common problems. A logical ending to development by joint committees is a central one formed from representatives of those committees. There is much more agreement with common working, an inter-connexion of undertakings, with pooling of supplies, but the form of administrative guidance that should be finally instituted has not yet emerged."

Scott Polar Research Institute

THE building of the Scott Polar Research Institute in Cambridge is to be formally opened by the Chancellor of the University, Mr. Stanley Baldwin, on November 16. The speeches will be delivered in the Senate House, as the building itself is scarcely fitted for the number of people likely to attend the opening; but it will be inspected afterwards and flood-lit in the evening. The building itself is a memorial to the late Capt. Robert Falcon Scott, whose tragic death with four companions on his return from the south pole in 1912 will still be fresh in the memories of many. The architect was Sir Herbert Baker, and he has succeeded in erecting a building which is both practical for the activities of the Institute and of pleasant appearance. Over the front door is a bust of Capt. Scott by Lady Hilton Young (Lady Scott), and in the forecourt is a symbolic statue by her to the memory of the whole of the polar party. The memorial character is carried into the building in the form of an entrance vestibule with two high domes, painted by Mr. Macdonald Gill with maps of the two polar regions, embellished with the ships and the names of many noted explorers of the past. The three floors accommodate respectively the collections of polar equipment, the library of polar books and maps, and the pictorial collections. On the walls of the attic gallery are hung many of the watercolours painted by Dr. E. A. Wilson, a member of the polar party. There are also four small rooms for the use of the director, staff and research students. After November 16, the building will be open to the public on weekdays, 10 a.m.–4 p.m.

New Building of the Radcliffe Science Library

THE new building of the Radcliffe Science Library was opened by the Princess Royal on Saturday, November 3. In Convocation on the same day, on the motion of the Master of Pembroke, an address of thanks was presented to Her Royal Highness. The Master of Pembroke gave a brief account of the history of the Library from its foundation by Dr. John Radcliffe, physician to William III and Queen Anne, with its original domicile in the building now called the Camera, its removal to the Museum, and its present status as a department of the Bodleian. The Princess Royal, through the Vice-Chancellor, expressed her gratification in being instrumental in throwing open facilities for scientific study which would be of the highest advantage not only to Oxford but also to the community at large. The new building is an extension of that erected in 1901 adjoining the Museum, and contains two large reading rooms, a three-deck bookstack and two rooms, one for rare books and the other for committees and similar purposes. Part of the first floor reading room has been set apart for mathematical teaching and research pending the erection of a mathematical institute. It is estimated that room will be available for a quarter of a million volumes. The new building, which has cost about £45,000, is the first stage in a scheme for the reorganisation and extension of the Bodleian Library, towards which the Rockefeller Foundation of New York is contributing three fifths of the total expenditure. At present the Radcliffe Science Library contains a number of books from the Bodleian which will eventually be moved to the main bookstack to be erected in Broad Street, thus setting free ample shelving for the scientific literature of future generations.

The Serial Universe

ON October 22 and 29, Mr. J. W. Dunne—in whose book, "An Experiment with Time", published a few years ago, evidence of apparent prevision of future events was presented, with a suggested explanation in terms of the character of the time concept—gave two lectures before the Royal College of Science Mathematical and Physical Society on "The Serial Universe". Mr. Dunne described the nature of a 'regress', in which every term except the first is defined by its relation to the preceding and following terms and which therefore produces an infinite series. He showed that if, in the traditional manner of physics, we regard the scientific description of the world as being necessarily based on the exploration of an objective system with independently existing instruments of observation, we are compelled to employ a concept of time which is regressive, though it has not hitherto been so recognised. Such a concept is adapted to our reasoning powers because we are self-conscious beings, and self-consciousness itself is essentially regressive. The difficulties of modern physics have arisen because attention has been concentrated on the first term only of the temporal regress, which lacks the vital double character of the succeeding terms. Mr. Dunne very acutely applied his ideas to the problems of relativity—attributing the appearance of 'imaginary' time in the Minkowski world to the rotation of the axis of second-term time though 90° into coincidence with that of first-term time—and to the quantum theory, in which the 'uncertainty' of Heisenberg's principle was found to be regressive and located in the instruments of observation instead of the world observed, which remained determinate. The substance of the lectures, considerably amplified, is to appear almost immediately in book form.

Mummy Wheat

POPULAR belief in the viability of wheat grains which have been interred in ancient tombs, sometimes thousands of years old, has during the past few years been severely shaken by morphological and physiological tests on genuine mummy wheat, and also by bringing into question the authenticity of other so-called specimens. But in many people's minds, the possibility of mummy wheat being viable seems still to exist. A survey of this subject was given in NATURE of May 2, 1931, p. 675, where genuine mummy wheat and the more questionable cases were discussed. In NATURE of August 19, 1933, p. 271, an example of some so-called mummy wheat from an Indian tomb was shown to be actually a recent one, the whole idea having been based, at the best, on a misunderstanding. The possibility of the inordinate longevity of some seeds clearly never fails to appeal to the imagination. An article reviewing work on this subject appeared in NATURE of September 23, 1933, p. 469. On September 6 last, Sir E. A. Wallis Budge offered, through the medium of the *Times*, to supply samples of wheat obtained from a nineteenth dynasty tomb in Western Thebes, to responsible institutions in order that the germinating capacity of these seeds could be tested. Although the results of all such tests have not been announced so far, attention should be directed to a report by Mr. W. H. Parker, director of the National Institute of Agricultural Botany, Cambridge, which appeared in the *Times* of October 29. After subjecting the seeds to strictly controlled germination tests, every grain had completely decayed within sixteen days, and had become attacked by a growth of mould. Morphological examination of the embryos before the tests had also indicated that the sample was incapable of germination.

Early Man in East Africa: Further Investigation

NOTWITHSTANDING the close and expert scrutiny to which Dr. L. S. B. Leakey's evidence for the early occurrence of man in Kenya has been subjected, the far-reaching effect of the conclusions to which it leads make it eminently desirable that no means of verifying and substantiating the data should be neglected. The geological evidence of deposits in Kenya, where volcanic action has been marked, has proved notoriously difficult of interpretation; and the announcement is, therefore, welcome that Prof. P. G. H. Boswell, of the Imperial College of Science, whose views on the interpretation of deposits with which relics of early man are likely to be associated carry considerable weight, is to proceed to Kenya for the purpose of investigating with Dr. Leakey the conditions of the discovery of relics of early man in East Africa. Prof. Boswell will leave London during the current month and he and Dr. Leakey will be joined in Kenya by Mr. E. J. Wayland, director of the Geological Survey of Uganda, who is at present home on leave. Mr. Wayland's extensive studies of the prehistory of man in Uganda, as well as his knowledge of geological conditions in Kenya and Tanganyika, will be of invaluable assistance in arriving at what, it may be hoped, will be final and decisive verdicts on the important questions which have given rise to controversy.

Samaria

THE article contributed to the *Times* of November 3 by Mr. J. W. Crowfoot, in connexion with the exhibition illustrating the excavations of Samaria now open at the rooms of the Palestine Exploration Fund at 2 Hinde Street, London, W., gives a very informative view of the general results which have been achieved by recent work on the site of the city of Ahab. It is evident that the joint expedition, for which Harvard University, the Palestine Exploration Fund and other bodies are responsible, has not only added a great deal to the map of ancient Samaria, as Mr. Crowfoot says, but it has also reached a most important phase in its undertaking in the proposed extension of the investigation on the north side of the site, where it is possible that the principal gate of the city may lie. The superior character of the stone work of the Israelitish levels was already known from the work carried out by the expedition of Harvard University in pre-War days. This skill in the construction of fortifications is confirmed by the discovery of the remarkable bastion to which Mr. Crowfoot refers. Even more suggestive of the influences at work in the northern kingdom are the remarkable ivories which have been discovered and are regarded as a corroboration of the reference by the prophet Amos to the "ivory couches" of Samaria, which these remains of plaques and other carvings once adorned. It may be trusted that the reference by Mr. Crowfoot to the dependence of the projected excavation on the provision of funds is a reminder rather than a warning.

Ancient Monuments in Cyprus

THE address on the "Ancient Monuments of Cyprus", delivered by Sir Charles Peers at the meeting of the Royal Empire Society on November 5, afforded ample justification—if justification were needed—for the appeal issued in the spring of this year by the influential Cyprus Committee, of which Lord Mersey is chairman, for funds for the preservation of these monuments. Sir Charles, as the result of a visit of inspection to the island, on which he was accompanied by Sir George Hill, director of the British Museum, was in a position to assure his audience, and through them, a wider public, of the unique character and exceptional interest of the long series of monuments, many of them of surpassing beauty, which extends from prehistoric times to the Turkish occupation. To the archæologist the island of Cyprus, which gave its name to the metal first put to practical uses by men, and which was a meeting place of the cultures of the Mediterranean, of Egypt, and of Asia, is a source of the material of prehistory of which the potentialities have yet to be explored systematically; while the historian and the student of art may here view within its restricted compass a sequence of Phœnician, Greek, Roman, Byzantine, Gothic, Renaissance and Turkish, scarcely surpassed,

if indeed equalled, in riches elsewhere—such riches, for example, as the Gothic buildings or the village churches with their painted decorations, to which Sir Charles referred. Since attention was directed recently to the danger which threatens the antiquities of the island, an inspector of antiquities has been appointed; this is only a partial discharge of the responsibility entailed by Britain's occupation of Cyprus since 1878, and its formal status as a colony since 1925, now that the inhabitants have fallen on evil days through the economic depression. On historical and æsthetic grounds, the Cyprus Monuments Fund (6 Pall Mall, London, S.W.1), for which several thousand pounds will be needed, deserves the fullest support.

Elements and Isotopes

THE first Friday evening discourse of the new session at the Royal Institution was delivered on November 2 by Dr. F. W. Aston, who took as his subject "Elements and Isotopes". That a chemical element could consist of isotopes of different atomic mass was first observed by Soddy when working on the products of radioactivity. Proof that this was true of the elements generally could only be obtained by direct atomic analysis. This was achieved by the mass-spectrograph, and with it the search for isotopes has been carried on continuously for the past fifteen years. Wide differences of properties among the elements necessitate very varied methods of obtaining the atomic rays required for the analysis. In some cases the technical difficulties are great; it is only during the last year that satisfactory results have been obtained with the rare earth group. Of the common elements, all but four, palladium, iridium, platinum and gold, have now been analysed and some 247 isotopes identified, a few by less direct optical methods. Elements of odd atomic number appear curiously limited to two isotopes, but elements of even atomic number can have many more, eleven in the case of tin. By means of modern instruments, it is possible to compare the masses of atoms to one part in ten thousand, an accuracy which it is expected to increase in the near future. These isotopic weights are required in order to test theories of nuclear structure, which have recently become of the greatest importance on account of the discovery of transmutation and of artificial production of radioactive isotopes.

Exploration of Nanda Devi

NANDA DEVI, with an altitude of 25,645 ft., in the Kumaun Himalayas, is supposed to be the highest mountain entirely within British territory. The area in which it lies is so rugged and unapproachable that even the base of the main peak defied assault until this year, though in 1907 Dr. T. G. Longstaff made an attempt via the Rishiganga gorge. In a letter to the *Times* of November 2, Mr. H. Ruttledge gives a preliminary account of an expedition to Nanda Devi led by Mr. E. E. Shipton this year. In June, with Mr. Tilman and a few native carriers, Mr. Shipton forced a way up the precipices of the Rishiganga gorge to the source of the river and explored the northern flank of Nanda Devi. Before the monsoon broke, they retreated northward and during July and August explored the Arwa, Bhagat-Kharak, and Satopanth glaciers before returning to their main task. Once more they ascended the Rishiganga gorge, mapped the southern basin of Nanda Devi, climbed a considerable distance up the peak and discovered a way that in the proper season would no doubt lead to the top. Finally, in September they crossed the difficult Sonadunga col and descended to the south. Mr. Shipton is returning to Great Britain next month.

Sixty Years' Progress in Naval Construction

SIR ARTHUR JOHNS, director of naval construction, for his Andrew Laing lecture to the North-East Coast Institution of Engineers and Shipbuilders on November 2, took for his subject "Progress in Naval Construction". Beginning with a comparison of the Navy in 1874 and 1934, he dealt in turn with materials, the development of the capital ship and of cruisers, torpedo vessels, submarines, aircraft on warships, model experiments, welding and stability and strength. Nothing perhaps was more striking than the figures he gave regarding tonnage, horse-power and speed. The displacement tonnage of our fighting ships in 1874 was 825,000 as compared with 1,275,000 of to-day, while the corresponding figures for horse-power are 590,000 and 9,500,000. A cruiser of 1874 had engines of 4,500 horse-power and a speed of 14 knots; a cruiser of to-day develops 72,000 horse-power and has a speed of 32½ knots. Though Sir Arthur Johns' review was necessarily a cursory one, it was a valuable authoritative review of the main lines of progress and contains references to many of the most interesting vessels ever launched. He paid an eloquent tribute to the work of William Froude, whose theory of a propeller's operation is still the simplest and most representative, and whose method of computing the skin resistance of full-sized ships has stood the severest tests. Regarding the stability of ships, this has been the bugbear of naval architects since the thirteenth and fourteenth centuries, and even after Bouquer had defined the meta-centre and shown how its position was determined, Atwood in a paper to the Royal Society proved to his own satisfaction that the meta-centre was a mere mathematical curiosity, useless to the naval architect. It was the researches of White and John after the capsising of the *Captain* in 1871 which made a marked advance in our knowledge of the stability of a ship and of the features which improve or adversely affect it.

Coal Mining in Great Britain

SIR RICHARD REDMAYNE delivered the presidential address to the Institution of Civil Engineers at the opening meeting of the new session on November 6. Sir Richard has been for many years associated with coal mining in Great Britain, and it was appropriate that he should discuss aspects of the industry. In tracing its development, he pointed out that the growth of the railway and the application of steam

to shipping gave a great impetus to the coal trade, the output in 1845 being three times that of 1800. Great progress has been made during the past fifty years in the technique of coal mining, and in many collieries the only manual labour now used in the actual coal-getting is shovelling the machine-cut coal at the face on to a band- or jig-conveyor. In 1900, 1·47 per cent of the coal raised in Great Britain, and 24·9 per cent of that raised in the United States, was machine-mined; in 1932 the figures were 38 and 68·3 per cent respectively. Natural conditions in the United States, however, are better suited than those of many British coalfields to this mode of working. The methods of supporting the roofs and sides of underground roads are now undergoing considerable change; of the 20,000 miles of main roadways in coal mines of Great Britain, 1,800 miles are supported by steel arches, and there are in addition about 900,000 steel props used in and about the workings. The ultimate possible demand for steel supports in Great Britain is 370,000 tons a year, a quantity which would provide employment for at least 10,000 workers. Turning to the subject of accidents, Sir Richard said that, of the larger coal-producing countries, the most favourable figures are shown by France with a death-rate of 1·0 in a thousand; other figures are 1·1 for Great Britain and Belgium, and 4·8 (bituminous coal) and 3·9 (anthracite) for the United States. The future of the coal trade is dependent, in Sir Richard's view, on increased scientific research and the discovery of new uses for coal.

University Degrees in Engineering

IN the *Engineer* for November 2 is the first of a series of articles on "University Degrees in Engineering", and the subject is referred to in a leading article. One aspect of this question, namely, the new regulations for 'external' degrees in engineering of the University of London, was discussed in NATURE of August 12, 1933, p. 222. It is well known, says the *Engineer*, that regulations and customs governing the granting by British universities of degrees in engineering are not uniform, each university being a law unto itself. The values of degrees, therefore, differ greatly. While it is admitted that to ask the universities to reduce themselves to a dead level of uniformity as regards the standard of their products would be to aim a blow at the very root of the conception behind university instruction and education, yet it is impossible to shut one's eyes to the fact that some measure of standardisation of the conditions under which engineering degrees are granted is overdue. As an impartial observer, the *Engineer* considers that unless the problem is attacked thoroughly and soon, the reputation of university degrees for engineers will suffer a severe decline. How the regulations differ is shown in the first of the articles in the series, which deals with engineering degrees granted by the Universities of Glasgow, Aberdeen, Edinburgh and St. Andrews. The survey is based on information contained in official publications and it should be of use to those about to select a centre of engineering education and also to those called upon to assess the value of British engineering degrees or of those who hold them.

Iron and Steel Institute: Co-operation with Local Technical Societies

ARRANGEMENTS have been made by the Council of the Iron and Steel Institute and the councils of various local technical societies for extending existing arrangements for co-operation between the Institute and such bodies. To this end, the Council of the Institute has agreed to extend the maximum age of associate membership from twenty-four years of age, as previously fixed, to thirty years of age in the case of associate members who are also members of local technical societies taking part in the scheme. It has also agreed to supply each year to the local societies, for presentation and discussion at local meetings, certain papers which have been presented at general meetings of the Iron and Steel Institute. One or two joint meetings each session between members of the local societies and members of the Iron and Steel Institute resident in the particular district will be arranged. It is hoped by these means usefully to extend the existing co-operation between the Institute and local technical societies, and particularly to encourage the study of problems connected with the manufacture and metallurgy of iron and steel, especially among the younger members of those societies. The secretary of the Iron and Steel Institute, 28 Victoria Street, London, S.W.1, will supply further information on request.

Picture Telegraphy

METHODS of transmitting pictures by telegraphy have been known for the last ten years. In a suitably constructed photoelectric cell, the electric current through it can be made proportional to the light falling on it. If a picture in the form of a film negative be moved between a constant source of light and a cell in such a way that the light beam passes successively, line after line, through each minute area of the picture, the current transmitted will vary in intensity. The receiver is complicated, but the amount of light from a local source varies with the current received and falls on a photographic film which moves in step with the original film. A photoelectric cell can only distinguish light from darkness. Unlike the eye, it cannot distinguish form and colour. Photographs can be transmitted in this way by both wired and radio telegraphy. A recent remarkable achievement was the photograph of the Duke of Gloucester sent from Australia by the Marconi facsimile system of radio picture telegraphy. A still greater achievement was the transmission of the pictures on ten feet of cinematograph film showing the arrival of Scott and Campbell Black at Melbourne. An example of a news picture sent by the ordinary telegraph services between London and various Continental towns was the funeral of King Alexander at Belgrade. For ordinary commercial purposes, we think that picture telegraphy might be more widely used with advantage. Possibly the facilities it gives have not been sufficiently advertised.

Commercial Insulin

WE have received from Messrs. Burroughs, Wellcome and Co., London, a phial of "Wellcome" brand insulin prepared from crystalline insulin. This is the first commercial insulin to be made from the crystals and is available in 5 c.c. phials at 20 units per c.c. When insulin was first placed on the market some ten years ago, the potency of the material was only a few units per milligram. For some time now, however, the potency of many commercial insulins has approximated that of the pure crystals, but this is the first time that the crystalline material has been employed for the preparation of insulin solution on the commercial scale. Crystals were first made by Abel in 1926 : the problem was further investigated by Harington and Scott in 1929, and more recently Scott has shown that the ease with which crystals can be obtained from amorphous insulin depends on the presence of small quantities of zinc (or some other metals), and that all crystals prepared by the pyridine-brucine or saponin methods contain this element.

Announcements

LORD D'ABERNON, chairman since 1929 of the Medical Research Council, has been elected a fellow of the Royal Society under Rule 12, which provides that the Council may recommend for election in any calendar year not more than two persons who "have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society".

MR. F. J. MARQUIS and Prof. W. W. Jameson have been appointed to fill vacancies in the membership of the Industrial Health Research Board of the Medical Research Council.

DR. KENNETH MELLANBY has been appointed Wandsworth scholar at the London School of Hygiene and Tropical Medicine. The purpose of the scholarship is research in tropical medicine, and the appointment is for a period of two years.

THE Director of the Geological Survey and Museum reports that Jermyn Street Museum is now vacated, and the library and collections have been transferred to the new Museum in Exhibition Road, South Kensington. The library is not yet in order, but the geological maps, British and foreign, are now available for consultation by the public. Admission may be obtained by the side entry in the courtyard between the Science Museum and the Geological Survey Museum.

THE next series of lectures and demonstrations on tropical hygiene at the London School of Hygiene and Tropical Medicine, which are intended for men and women outside the medical profession proceeding to the tropics, will be given by Lieut.-Col. G. E. F. Stammers and Sir Malcolm Watson on December 10–14 inclusive, 3.30–5 p.m. each day. The synopsis and other particulars can be obtained from the Organising Secretary, Ross Institute of Tropical Hygiene, Keppel Street, Gower Street, W.C.1.

THE Secretaries of the Fourth International Congress for Applied Mechanics held in Cambridge last summer are about to go to press with the *Proceedings* of the Congress. So that the data contained may be at the disposal of all actively interested in the subject, the Organising Committee is prepared to issue copies at a price of £1 including postage (which sum does not actually cover the cost of printing and distribution). So that an adequate number of copies may be printed, those desirous of availing themselves of this offer are advised to make application forthwith to the Organising Secretary, Engineering Laboratory, Cambridge, England. The volume will contain the seven general lectures *in extenso*, abstracts of about 140 sectional papers and other data relating to the Congress.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A research student (qualified medical practitioner) for six months at the Institute of Pathology and Research, St. Mary's Hospital, Paddington, London, W.2—The Secretary (Nov. 12). A head of the Department of Continuative Education, Loughborough College—The Principal (Nov. 16). A lecturer in engineering at the Widnes Municipal Technical College—The Secretary, Education Office, Town Hall, Widnes (Nov. 16). A temporary junior assistant at the Experimental Station, Porton, near Salisbury—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (Nov. 17). A lecturer (woman) in mathematics and science (biology) at the Training College for Women, Langham Tower, Sunderland—Chief Education Officer, Education Offices, 15 John Street, Sunderland (with stamped addressed envelope) (Nov. 19). An electric traction engineer to the New Zealand Government Railways—High Commissioner for New Zealand, 415 Strand, London, W.C.2 (Nov. 24). An explosives chemist for the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (Nov. 24). An assistant to the Secretary of the Institution of Naval Architects—The Council of the Institution, 2 Adam Street, Adelphi, W.C.2 (Dec. 1). An assistant lecturer in mechanical engineering at the Manchester Municipal College of Technology—The Principal (Nov. 26). A University demonstrator in pathology at the University of Cambridge—Prof. Dean, Department of Pathology, (Dec. 1). Librarian at the British Postgraduate Medical School (University of London)—The Dean, British Postgraduate Medical School, New Public Offices, Whitehall, S.W.1. A professor of modern experimental physics at the National Central University, Nanking, and a professor of hydraulic engineering at the National Chekiang University, Hangchow, China—Universities China Committee in London, 91 Gower Street, London, W.C. A research fellow (experience in gas analysis) at the Liverpool Heart Hospital—The Secretary, Miss Lewis, 14, Cook Street, Liverpool.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Direct Introduction of Deuterium into Benzene without Heterogeneous Catalysis

THE transference of deuterium to benzene from hydrogen gas or from water at the surface of finely divided metal catalysts has been realised by Horiuti, Polanyi and Ogden[1], and unsuccessful attempts to achieve a similar object have recently been recorded by Farkas, Farkas and Rideal[2] and Murray, Squire and Andrews[3].

We are studying the direct introduction of deuterium into the aromatic nucleus by means of ordinary electrophilic reagents, that is, without heterogeneous catalysis, and it may be of interest if some of our results for benzene itself are set out for comparison with the above catalytic studies.

The reagent employed for the introduction of deuterium into this hydrocarbon was concentrated aqueous sulphuric acid. It was prepared from sulphur trioxide and the appropriate quantity of heavy water. When benzene was treated with anhydrous sulphuric acid extensive sulphonation took place, but this was largely avoided by the use of 90 per cent acid. When the latter acid and benzene were brought together hydrogen exchange readily occurred.

Quantities of benzene and aqueous acid each containing the same number of atoms of hydrogen ($\frac{1}{3}C_6H_6+H_2O+xSO_3$) were shaken together for various periods at the room temperature. The benzene was neutralised, dried and burnt, and the density of the combustion-water was determined. When the sulphuric acid had the ordinary hydrogen-isotope ratio the combustion-water had the same density as ordinary water to within the accuracy of the density measurements (1 in 10^6). When, however, the acid had an enhanced deuterium content, a part of this isotope became transferred to the benzene, which on combustion yielded heavy water. For times of shaking up to 24 hours the proportion of deuterium thus transferred increased with the time. The following two experiments with a specimen of 90 per cent sulphuric acid prepared from water having a density of 2,149 parts per million above normal will give an idea of the velocity of the exchange (the equilibrium constant is being determined):—

Time of shaking (hours)	Excess density in p.p.m. of	
	H_2O of residual (H_2O+xSO_3). By diff.	Combustion H_2O from C_6H_6
3	2060	89
24	1199	950

Results will later be reported showing that certain substitution products of benzene undergo spontaneous exchange of their nuclear hydrogen atoms with the hydrogen of water or acids much more readily than does benzene itself.

It is well known that the familiar substitution effects of reagents such as sulphuric acid require the assumption of 'abnormal' polarisation, that is, polarisation in a direction contrary to that of the ordinary ionisation of the reagent (for example, $\overset{\delta-}{OH}-\overset{\delta+}{SO_3H}$). The existence of an aromatic substitution dependent on 'normal' polarisation ($\overset{\delta+}{H}\rightarrow\overset{\delta-}{SO_4H}$), that is, one corresponding to the ionisation, is here demonstrated for the first time. Evidently the reaction is facile, though undetectable except by the use of an isotopic indicator.

C. K. INGOLD.
C. G. RAISIN.
C. L. WILSON.

University College,
London.
Oct. 30.

[1] *Trans. Faraday Soc.*, 30, 663; 1934. Cf. NATURE, 134, 377, Sept. 8, 1934.
[2] *Proc. Roy. Soc.*, A, 146, 639; 1934.
[3] *J. Chem. Phys.*, 2, 714; 1934.

Composition of Cosmic Rays

THE new information regarding the absorption of high energy photons and electrons, presented at the recent International Congress on Nuclear Physics, suggests an improved interpretation of certain cosmic ray phenomena. Three distinct components of cosmic rays have been recognised. Eckart's analysis[1] of the depth *v.* ionisation data shows clearly the presence of two components in the cosmic rays which reach the earth's surface. These components have mean absorption coefficients of about 0·6 and 0·06 respectively per metre of water. Gross[2] and Compton and Stephenson[3] find that the high altitude data from stratosphere balloons also indicate the presence of two components, the more penetrating of which is probably identical with Eckart's less penetrating component. Let us call these components *A*, *B* and *C* in the order of their penetrating power.

Following the theories of Størmer, Lemaître and Vallarta, and others, we can calculate the minimum energies of electrons, protons and alpha particles which reach the earth at a given latitude through the earth's magnetic field. Corresponding to these minimum energies, there will be minimum ranges in the atmosphere. Component *A*, which is relatively most prominent near the top of the atmosphere, is affected less by the earth's magnetic field than component *B*. Its penetration corresponds either to the range of alpha particles capable of traversing the barrier of the earth's magnetic field, or to photons with the absorption coefficient of the shower producing radiation.* Our approximate calculations show a close correspondence between electron ranges†

* This suggestion of photons for component *A* has been put forward by P. M. S. Blackett, because of the close correspondence between its rate of absorption and that observed for the shower-producing radiation, which seems to consist of photons. It is also doubtful whether alpha particles could retain their integrity with kinetic energies hundreds of times greater than that (3×10^7 electron volts) with which they are bound together. Compton and Stephenson found the assumption of either photons or alpha particles to be consistent with their high altitude data. A comparison of the new high altitude ionisation measurements of Bowen, Millikan and Neher, with the earlier ones of Regener and Piccard at slightly lower magnetic latitudes, however, suggests an effect on this component due to the earth's magnetic field. This would require a charged particle rather than a photon composition. High altitude measurements now under way at lower magnetic latitudes, where the effect of the earth's field is greater, should serve to distinguish between the alpha particle and the photon hypotheses.

† Using a less complete theory, Compton and Stephenson[3] calculated that the electrons would have slightly greater penetration than the protons. The new results, which take into account the radiation excited by the particles on traversing matter, make their component *B* correspond to positrons rather than to the protons which their calculation favoured.

and component B. The minimum ranges for protons penetrating the magnetic barrier should be greater than for electrons, which suggests identifying protons with component C, though the presence of the strong component B prevents using existing depth-ionisation data to make this identification definite. These comparisons will be given in detail elsewhere. We wish here to point out that if component B is identified with electrons (positrons or negatrons), and C with protons, certain cosmic ray phenomena find a simple explanation.

Recent theoretical studies have shown that for the very high energies involved in cosmic rays, the probability that electrons shall lose energy by photon excitation increases rapidly with the energy, and should represent the most important method of energy dissipation. This deduction is supported by Anderson and Neddermeyer's measurements of electron energy losses, as reported to the Congress. For protons, however, the theory indicates that energy losses by photon excitation should be of negligible importance. This difference between the action of electrons and protons would account for the higher absorbability of the former, assuming that both types of particles have roughly the same distribution of energies. An equally important difference is that the electrons will form a prolific source of secondary radiation, showers, etc., whereas the protons should be accompanied by relatively feeble secondary rays. Component B should thus be the primary 'shower-producing radiation'.

The increasing importance of component B as compared with C at higher altitudes must accordingly result in an increased proportion of secondary radiation. We would thus explain the following phenomena:

1. The increasing importance of the transition effect at higher altitudes, as found by surrounding an ionisation chamber with several centimetres of lead.*

2. Rossi's new observation, as reported at the Congress, that the ratio of the frequency of showers to the frequency of coincidences increases at high altitudes (up to 3,500 metres).

If protons require less energy to penetrate the atmosphere than do electrons, the slowest protons reaching sea level had initially, at the top of the atmosphere, less energy than the slowest electrons. Therefore the protons should be more affected by the earth's magnetic field than the electrons, because they had less energy and therefore smaller mass when under the influence of the field. This would mean that at a given level the penetrating component C should show stronger magnetic effects than component B and its secondary radiation. Rossi has measured the difference between the number of rays coming from the west as compared with the east, at 45° zenith angle, and found this difference to be greater for the rays penetrating 8 cm. of lead than for the total radiation. Also, Johnson's measurement of the shower-producing radiation, using three counters not in line, showed a smaller west-east difference than that for the coincidence-producing radiation. This phenomenon is likewise explicable if it is the electrons of high initial energy which produce the showers, whereas the initially slower non-radiating protons which contribute to the coincidences are more easily deflected by the earth's field.

There is another possible reason why the electrons (and therefore the showers) show a smaller east-west effect than the protons (and therefore the total *primary* radiation): It may be that component B consists of negatrons as well as positrons, whereas component C contains only particles of positive charge, namely, protons. Johnson's observations at high altitudes in Peru that more rays come from the west than from north or south, however, is difficult to reconcile with any negatively charged particles prevented from reaching the earth by the field there used. This points to the conclusion that the electron component of cosmic rays consists at least predominantly of positrons.

A. H. COMPTON.
18 Norham Gardens, Oxford.

H. A. BETHE.
Physical Laboratories, Bristol.

Oct. 29.

[1] C. Eckart, *Phys. Rev.*, **45**, 851; 1934.
[2] B. Gross, *Z. Phys.*, **83**, 217; 1933.
[3] A. H. Compton and R. J. Stephenson, **45**, 441; 1934.

* Cf., for example, A. H. Compton (*Phys. Rev.*, **43**, 387; 1933) whose curve *a*, Fig. 3, shows the increase with increasing altitude of the fraction of the cosmic rays removed by 2·5 cm. of lead.

Secondary Emission from Elements Bombarded with Neutrons

WE have measured the absorption of the complex radiations from Po + Be in various elements, using a Geiger-Müller counter as a detector. The source of Po + Be (3·5 mc.) was enclosed in a glass tube and shielded with a cylinder of lead 2·5 cm. in thickness. The walls of the counter, which was placed 12 cm. from the source, were of aluminium, 0·18 mm. thick. The absorbing material was in the form of large slabs placed between the source and the counter. The following results have been obtained:

	C	Al	Fe	Zn	Sn	Sb	Ba	Hg	Pb
At. Weight	12	27	54	64	120	122	138	201	208
μ in cm.$^{-1}$	0·050	0·095	0·195	0·182	(0·00)	(0·06)	0·098	0·279	0·300
H/ρ in cm.^{2} gm.$^{-1}$	0·034	0·037	0·025	0·025	(0·00)	(0·010)	0·026	0·021	0·026

It is seen that tin shows no detectable absorption; antimony, which follows tin in the periodic system, shows an abnormally low absorption. A plate of lead, 8 mm. in thickness, interposed between the absorbing screen and the counter, reduced the number of kicks to half. It would appear, then, that the apparent low absorption in tin and antimony is to be ascribed to more absorbable secondary radiations produced by the passage of the primary rays through these elements. It seems probable that the softer radiations are of the nature of γ-rays, and arise from excitation of nuclear levels of elements near tin in the periodic table. It will be necessary to use stronger sources of neutrons and a modified technique in order to investigate these secondary soft radiations in greater detail; and we hope shortly to be able to report more fully on their nature.

ZAIRA OLLANO.
Institute of Physics,
Royal University,
Cagliari.

IN the course of observations of the neutrons produced by the bombardment of elements with

accelerated heavy hydrogen ions, we have noticed repeatedly the production of remarkably strong ionising radiations when silver was placed in the beam. Silver is close to tin in the periodic table and it is probable, therefore, that the effects observed by Dr. Ollano are due to the neutrons in the radiation from Po+Be, and that the phenomenon is general in elements in that part of the periodic table.

M. L. OLIPHANT.

Cavendish Laboratory,
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Oct. 27.

Vision in the Ultra-Violet

IN a letter in NATURE of September 15, p. 416, Mr. Goodeve refers to a paper by Saidman and Dufestel[1] on vision in the ultra-violet. Mr. Goodeve is probably unaware of a more recent paper by Saidman[2] on the same subject, where evidence is given of vision down to the mercury line 3130. Furthermore, Saidman has pointed out another remarkable fact worthy of note; that is, that vision at short wave-lengths is possible only in young people; the limit of visibility recedes towards longer wave-lengths with increase in age.

I can support this statement from the case of my own eyes. Twenty-five years ago, I was able to see the 3650 mercury line very well (I did not try with shorter wave-lengths, on account of the difficulty of excluding diffuse light). At the present time, at the age of sixty-seven years, I cannot see the 3650 line at all. My sight, in other ways, has remained perfectly normal, except the inevitable far-sightedness and slight hypermetropia. I can see the *K* line of calcium (3933) quite well.

This continuous retrogression in the limit of visibility is, without doubt, due to progressive absorption with age by the crystalline lens. As Saidman has remarked, the determination of the limit of visibility would give an indication of the age of the crystalline lens.

Nevertheless, certain precautions are necessary when determining this limit. It is necessary, in particular, to avoid all traces of diffuse light. Saidman used a mercury lamp with filters; but the number of intense lines is not large enough to fix a precise limit. From this point of view, a richer spectrum, such as that of iron, or even a continuous spectrum would be better; but there must be complete elimination of diffuse light. The use of a double spectroscope would probably be necessary in order to get a perfectly pure spectrum.

CHARLES FABRY.

University of Paris.
Oct. 18.

[1] *C.R.*, **182**, 1173; 1926
[2] *C.R.*, **196**, 1537; 1933.

Development of the Spark Discharge

IT has recently been shown[1] that in the lightning discharge a preliminary discharge from cloud to ground occurs before the passage of the main stroke in the reverse direction. The luminous intensity of this preliminary discharge is much lower than that of the succeeding main stroke and its velocity of propagation is considerably smaller. The main stroke begins at the moment the preliminary leader reaches the ground and follows the leader path in the reverse direction.

Now it has been observed in the laboratory for some years that when an impulse voltage is applied to an asymmetrical gap (such as a point-plane gap) the voltage of the impulse being insufficient to cause spark-over, a discharge proceeds from the high voltage point electrode towards the plane electrode, the length of the discharge varying with the applied voltage. Under conditions favourable for observation, this discharge can be followed almost to the plane electrode when the voltage is just insufficient to cause spark-over. It is natural therefore to suppose that this preliminary discharge forms the conducting path for the main discharge when spark-over occurs, thus providing an exact analogue of the lightning discharge. The difficulties of observing this are connected with the short time available for the development of the preliminary discharge and its weak visual intensity.

To overcome these difficulties a camera was constructed consisting of a wide aperture lens and a

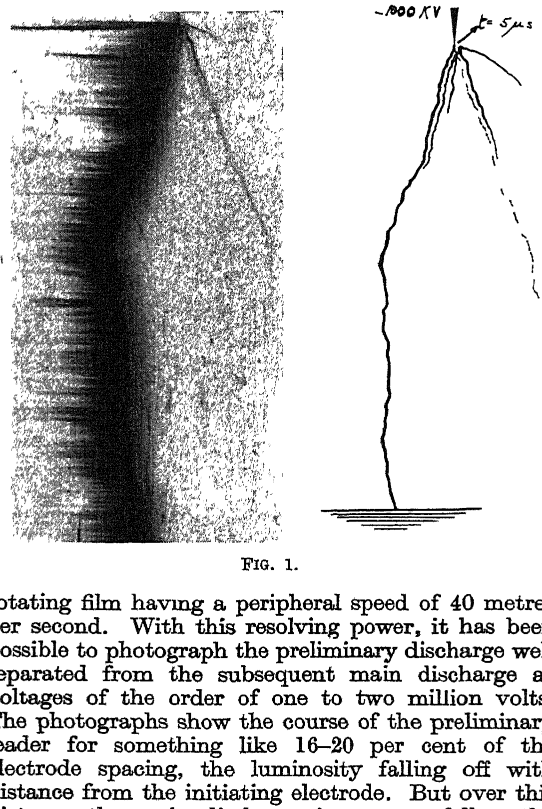

FIG. 1.

rotating film having a peripheral speed of 40 metres per second. With this resolving power, it has been possible to photograph the preliminary discharge well separated from the subsequent main discharge at voltages of the order of one to two million volts. The photographs show the course of the preliminary leader for something like 16–20 per cent of the electrode spacing, the luminosity falling off with distance from the initiating electrode. But over this distance the main discharge is seen to follow the path of the leader in all its details, and there is some evidence that where branching of the leader stroke occurs, the subsequent main stroke branches likewise. In Fig. 1 is shown on the left a record of the discharge between a negative point at − 1,000 k.v. and a grounded plane, 40 inches apart; and on the right a sketch indicating the extent to which the leader can be followed in the original.

Evidence obtained from Boys's camera investigations indicates that the speed of the camera here used can give rise to no displacement of the image of the main discharge. We therefore interpret an observed diminution in the separation between leader and main discharges as arising from the time occupied in the progress of the leader.

An important consequence of these investigations is that the interval between the start of the leader discharge and the occurrence of the rapid main discharge should be equal to the time lag of spark-over as measured by one of us[2] and should vary with the type of gap used. This is found to be the case, measurements of time-lag on the photographic film and on an oscillograph agreeing within 10 per cent. It is concluded that the time-lag of spark-over is the time taken for the leader stroke to bridge the gap between the electrodes.

It is found that leader strokes form whether the high-tension electrode is positive or negative. They also form from the grounded electrode upwards if the field is sufficiently concentrated there and reduced in intensity at the high-tension electrode. It is to be expected that with the types of gap so far investigated, the visual intensity of the leader stroke should diminish rapidly with increasing distance from the high-tension point since the average gradients for positive and negative polarities are only about 6–10 k.v. per cm. and the average speeds of formation of the leader strokes are only about 6–20 × 10^6 cm. per second respectively. The greater speed of formation of the leader stroke in the lightning discharge corresponds to the greater uniformity of the field and the higher average gradients prior to the lightning discharge. It has been found in support of this view that an increase in the applied voltage over the minimum voltage required to produce spark-over results in an increased length of the leader stroke having sufficient intensity to be recorded photographically. The velocity of the leader is increased and the time-lag, as is well known, is diminished by this procedure.

We wish to thank the members of the High Voltage Laboratory, Metropolitan-Vickers Electrical Co., Ltd., for assistance with the impulse generator and cathode ray oscillograph used in this preliminary survey of the spark discharge development; the South African Institution of Electrical Engineers for the loan of a camera used in a subsidiary investigation; Mr. Olaf Bloch of Messrs. Ilford, Ltd. for assistance with photographic material; and Mr. A. P. M. Fleming, director and manager of the Research and Education Departments of the Metropolitan-Vickers Electrical Co., Ltd., for permission to publish this account.

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B. F. J. SCHONLAND.

University of Cape Town.
Oct. 18.

[1] Schonland and Collens, *Proc. Roy. Soc.*, A, **143**, 654; 1934.
[2] Allibone, Hawley and Perry, *J. Inst. Elec. Eng.*, November, 1934.

A High-Frequency Water Jet, and Ultrasonic Flame

IF two capillary jets of water impinge upon one another, one may observe several interesting things, some of which are recorded below. Fig. 1 shows the double nozzle used. It is made of glass with holes about 0·5 mm. in diameter at the tips, and is provided with a spreader. A water pressure of about 0·3 atm. was used.

Fig. 2 is a picture of the jet by reflected light. It is remarkable in that it shows stationary corrugations (probably Rayleigh waves such as formed by an obstacle touching a stream) on the flat surface of the jet, and space periodicity, due to the pulsation of

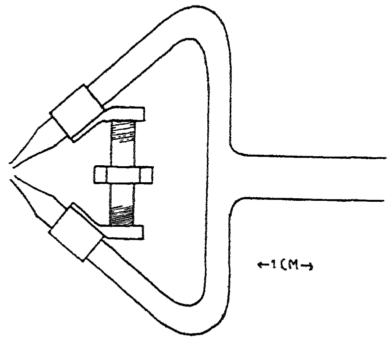

FIG. 1.

droplets (Plateau) in the tangential streamers. The jet emits a faint note of high frequency. The intensity of the note can be greatly increased by blowing a jet of air against the film or any of its streamers.

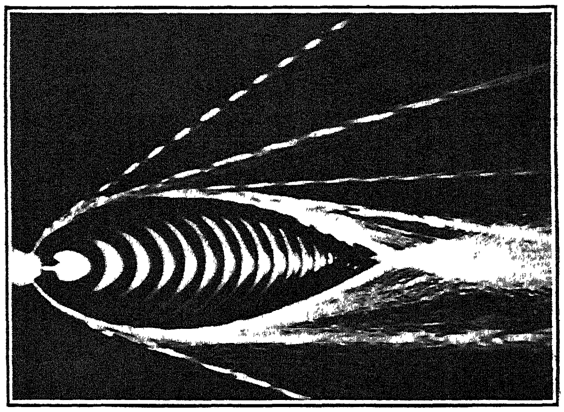

FIG. 2.

Fig. 3 is a spark photograph of the jet in transmitted light. It is seen that the droplets in any one of the streamers all have the same size, and that the droplets in all the streamers have the same frequency

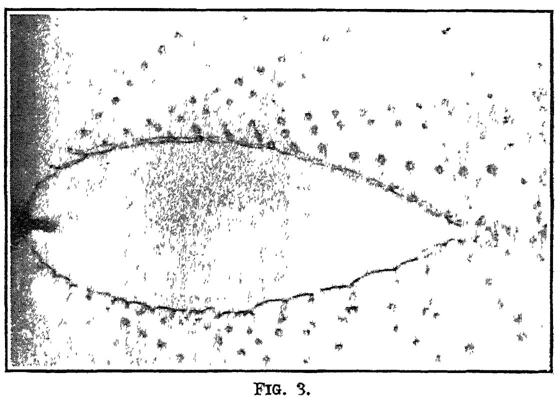

FIG. 3.

spacing. The stroboscope shows that this is the frequency of the emitted note. The stroboscope also shows waves of this frequency travelling outward from the nozzles and riding over the stationary corrugations.

Fig. 4 shows the manner of propagation of these waves. In this picture the stationary corrugations are seen as a vertical plaid. The horizontal lines at the top and bottom are time signals $\frac{1}{60}$ sec. apart. The oblique lines are the traces of the moving waves. The picture was made by light reflected from the jet in the same manner as Fig. 2. However, in this case a slit diaphragm was placed immediately before the photographic film, and the film jerked upward past the slit. The light from the stroboscope flashed through the slit on to the moving film leaving a time record. Hence the picture has both time and space

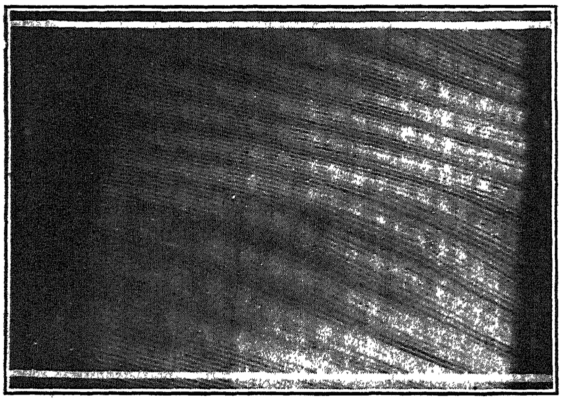

FIG. 4.

co-ordinates. Coarse and fine waves are seen to be present and both travel with the *same speed*, which is proportional to the slope of the oblique traces. The frequency of the long and short waves as counted from this picture are 600 and 4,200 respectively. The wave-length of the latter is 1·2 mm.

The jet seems to be a new method of producing droplets of uniform size, and one can apply Rayleigh's formula for studying their pulsations and hence the surface tension of newly formed surfaces.

This double nozzle when used with burning gas gives a *noiseless* ultrasonic flame.

JOHN J. HOPFIELD.

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Toledo, Ohio.
Oct. 4.

Wasting Disease of *Zostera marina*

IN connexion with the various investigations into the local disappearance of the grass wrack[1], it has been noticed that the smaller narrow-leaved form of *Zostera marina* has, in some cases, replaced the larger type. Attention was thus focused on this *Z. marina* var. *angustifolia*, and it was suggested that it might have originated from a cross with the smaller species *Z. nana*. Dr. Butcher[2] was unable to find any definite morphological or anatomical support for this view, but suggested that chromosome studies might clear up the situation.

Studies have therefore been made of the root tips of *Z. nana* and of five stocks of *Z. marina* from localities so wide apart as south-west Ireland and north-east England. All the material showed a somatic complement of 12 chromosomes but, on the other hand, investigation of the size and structure of the chromosomes gave a clearly marked distinction between *Z. nana* on one hand and all forms of *Z. marina* on the other. The complements of all stocks of the latter are indistinguishable, and consist of six pairs of comma-shaped chromosomes of which one pair carries large satellites, and the spindle fibre attachment is characteristically sub-terminal. In *Z. nana* the chromosomes are at least twice as large and there are much more clearly marked differences in size among them, chromosomes with median spindle fibre attachments are conspicuous and the satellites on the largest pair of chromosomes are relatively small. Fig. 1 gives typical plates from the two species (× 2250).

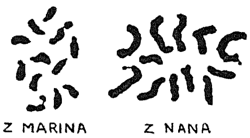

FIG. 1.

The differences between the chromosomes of the two species seem to be sufficiently marked for them to be distinguishable in a hybrid, but in the narrow-leaved form of *Z. marina* the complement is identical with that of the type; thus the probability that the former is not a hybrid seems to be almost a certainty. That the difference may be an ecological one is suggested by the observation that, in the localities examined, the width of the leaf in *Z. marina* was directly proportional to the depth of the water, the very narrow-leaved forms being longest exposed by the fall of the tide and the broadest not exposed at all. The *Z. nana* forms a zone still farther up the shore than the narrowest *Z. marina*.

KATHLEEN B. BLACKBURN.

Armstrong College,
Newcastle-on-Tyne.
Oct. 11.

[1] NATURE, **132**, 277, Aug. 19; 483, Sept. 23; 752, Nov. 11; 1004, Dec. 2; 1933. **133**, 912, June 16, 1934. **134**, 143, July 28; 416, Sept. 15; 573, Oct. 13; 1934.
[2] B.E.C. Report, 1933.

Specific Action of Œstrin

IN a communication concerning the effect of œstrin upon certain vestigial structures in the male mouse, Burrows[1] has made the interesting suggestion that this effect may be specifically upon the derivatives of the Müllerian apparatus, and points out the possible use of this in embryology.

I have recently concluded an examination of the oviducal epithelia of the mouse, to be published elsewhere, and from this it appears that, while the outer portion of the Müllerian duct gives rise to structures lined with epithelia the behaviour of which is intimately affected by the march of events in the ovary, the inner portion produces epithelia one of which exhibits a behaviour which is apparently unique (the extrusion of nuclei and associated phenomena) but which yet cannot be closely related to any cycle.

It will be interesting to see whether further inquiry shows that one part of the Müllerian duct vestigial in the male is more sensitive to œstrin than another part functional in the female.

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Oct. 13.

[1] BURROWS, H., NATURE, **134**, 570, Oct. 13, 1934.

Infra-Red Spectra of Silica

AN experimental investigation of the infra-red absorption of transparent silica between 1·0 and 7·5 μ has resulted in the correction and extension of existing data, with the consequent possibility of formulating a set of vibration frequencies which appear to have more significance than those hitherto put forward. Pending detailed publication it may be useful to summarise some of the results.

Absorption coefficients and wave-lengths have been measured using a wide range of thicknesses of fused silica and crystalline quartz and a considerable improvement in both accuracy and resolution has been effected. Many new bands have been found in crystalline quartz; on the other hand, one recorded by Plyler[1] at 2·72 μ was definitely absent, as were also several bands reported by Parlin[2] in fused silica between 2 and 4 μ. Another of these, near 2·73 μ (Drummond), shows such markedly different intensities in different specimens that it is unlikely that it is due to silica at all. There are grounds for attributing it to dissolved CO_2.

TABLE 1.

	Total No. of bands	No. ascribable to harmonics	No. ascribable to combinations	No. of bands omitted
Fused Silica	14	11	—	3
Quartz (ω)	38	18	10	10
Quartz (ε)	29	14	8	7

The absorption spectra of fused silica and of the ordinary and extraordinary rays in quartz have been examined. That of fused silica is the simplest, and of fourteen bands, eleven can be fairly well represented as harmonics of five frequencies. (Two very weak bands and that at 2·73 μ are omitted.)

The spectra of quartz are more complex, but bands corresponding to those of fused silica can be picked out, the associated five frequencies deduced and further bands ascribed to additional harmonics and combinations. The numbers of bands included in this scheme are indicated in Table 1.

TABLE 2.

(Frequencies are in cm.$^{-1}$; * indicates reflection measurements)

	ν_1	ν_2	ν_3	ν_4	ν_5
Fused Silica	1120	935	799	746	659
Quartz (ω)	1129	937	797	751	663
Quartz (ε)	1131	932	800	751	666

$\nu_x - \nu_5$ (Fused)	461	276	140	87
,, (ω)	466	274	134	88
,, (ε)	465	266	134	85
Raman Effect (Fused)	444; 500	263	?	?
Raman Effect (Crystalline)	464	265	126	85
Far Infra-red (Fused)	472*	?	116	85
Far Infra-red (ω)	476*	263	130	95; 82
Far Infra-red (ε)	507*	?	?	?

There are several simple numerical relationships between these five frequencies (for example, $2\nu_1 = 3\nu_4$; $\nu_2 = 2\nu_1 - 2\nu_5$; $2\nu_3 = \nu_2 + \nu_5$; $4\nu_2 = 5\nu_4$; $5\nu_3 = 6\nu_5$), and they may, therefore, not be true fundamentals but be themselves formed from a simpler set of frequencies. Each of them, however, occurs in an independent harmonic series in the observed absorption spectra.

These quasi-fundamentals are, further, related to the far infra-red spectrum[3] and to the Raman effect[4], as may be seen by taking differences between ν_5 and each of the others. This relationship is set out in Table 2.

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[1] Plyler, *Phys. Rev.*, **33**, 48; 1929.
[2] Parlin, *Phys. Rev.*, **34**, 81; 1929.
[3] Barnes, *Phys. Rev.*, **39**, 566; 1932. Lecomte, "Le Spectre Infrarouge", pp. 145–6.
[4] Gross and Romanova, *Z. phys.*, **55**, 744; 1929. Menzies, *Phil. Mag.*, **8**, 504; 1929.

Synthesis of Ascorbic Acid (Vitamin C) by means of Tissues *in Vitro*

THE Tillmans technique of titration against the indicator 2:6-dichlorophenol indophenol has been modified by Harris and Ray[1] for the estimation of ascorbic acid in trichloroacetic acid extracts of different materials. By employing the same method, slightly modified by the introduction of glacial acetic acid before titration[2], we have been for some time investigating the nature of the precursor and mechanism involved in the synthesis of ascorbic acid by the rat, a species known to be independent of an external source of the vitamin.

The production of ascorbic acid by means of the liver, kidney and spleen tissues of the rat from glucose, fructose, galactose, mannose, arabinose and xylose has been studied. The minced tissues (0·2 gm.) were incubated at 37° in phosphate buffer of *p*H 7·4 (5 c.c.) or in a mixture of the phosphate buffer (2 c.c.) and Ringer-Locke solution (3 c.c.) for 3 hours with and without the different sugars (20 mgm.). Rather unexpected results were obtained, as will be seen from the following table, which gives average figures. Mannose appears to be almost unique among the sugars investigated in being converted into ascorbic acid by all these tissues under the stated conditions, and the amount of ascorbic acid formed is significant. The values obtained with the other sugars appear to be within the range of individual variations.

Ascorbic Acid (mgm.) formed per gm. tissue after incubation with sugar.

	Spleen	Kidney	Liver
Glucose	− 0·025	− 0·036	− 0·107
Fructose	− 0·050	+ 0·075	− 0·130
Galactose	0	− 0·050	− 0·060
Mannose	+ 0·350	+ 0·320	+ 0·300
Arabinose	− 0·010	+ 0·040	− 0·038
Xylose	− 0·022	+ 0·010	+ 0·025

The mechanism concerned in the dehydrogenation of mannose into ascorbic acid is under investigation. It is interesting to note that Ray[3] has, meanwhile, observed that in pea-seedlings mannose has a remarkable influence on the formation of ascorbic acid. This would indicate a similarity between the mechanisms involved in the above transformation occurring in the animal and plant tissues investigated.

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[1] Harris and Ray, *Biochem. J.*, **27**, 303; 1933.
[2] Guha and Gosh, *Current Science*, **2**, 390; 1934.
[3] Ray, *Biochem. J.*, **28**, 996; 1934.

Research Items

Early Records of Californian Indians. Mr. J. P. Harrington, of the Bureau of American Ethnology, has recently discovered the manuscript, which had long been missing, of the earliest, and indeed the only, account of the Indians of California dating from the period of the Spanish occupation, which is worthy of the name of an ethnological treatise. The author, Fr. Jerónimo Boscano, was a Franciscan missionary, born in the island of Mallorca in 1776, who worked at San Juan Capistrano from 1812 until 1826 and died in 1831. The Indians of San Juan Capistrano whom he described are a north-western sub-division of the San Luiseño Indians of the San Luis Rey Mission, who speak a dialect of the Aztecan family of languages. They had almost disappeared before they came under modern scientific observation. A version of Boscano's account was published in 1846; but the manuscript proves to be far more valuable than was expected, as it contains data not in the published version, and, indeed, the two supplement one another in important particulars. The treatise centres around the cult of Chinigchinix, who had once lived among the people as a prophet. On his death, it was believed, he was translated to heaven, leaving no visible remains behind. From heaven he continued to watch his people, and to judge and punish them for wrong-doing. In addition to his account of their cult the author describes the relation of the people to their chiefs, their marriages, their principal feasts and their calendar together with some miscellaneous customs. The temple of Chinigchinix was so sacred that no boy or girl was allowed to approach it, and it was an effectual sanctuary for anyone guilty of any crime. Mr. Harrington has published a translation of the manuscript (*Smithsonian Miscellaneous Collect.*, 92, No. 4) and is also preparing a full commentary on the material it records.

Petroglyphs in the Society Islands. A study of stone remains in the Society Islands (*Bull.* 116, Bernice P. Bishop Museum, Honolulu) by Mr. Kenneth P. Emory, based partly on material collected by Dr. E. S. C. Handy in 1923 and partly on that collected by the author as a member of the Bernice P. Bishop Museum's Expedition to the Tuamotu Archipelago on various occasions between 1925 and 1931, describes, among other matters, a number of petroglyphs which have been discovered on Tahiti, Huahine, Raiatea, Borabora and Maupiti. In Tahiti the petroglyphs are on large boulders, but in the Leeward Islands on slabs of maraes as well. Their uniformity and conventionality prove that the making of petroglyphs was a well-established practice. The motives are the turtle, which predominates, the human figure, concentric circles, circles and dots, and the canoe. They fall within the period of the historical inhabitants, but there is no means of dating them. Human figures at Tipaeni, Tahiti, are traditionally said to commemorate the wife and twin children of one Tatauri, who took refuge there, but this has the appearance of a local legend rationalised to fit the carving. Most petroglyphs are wrought by pecking. None of the groups is organised to portray an event or to form a decorative ensemble. The figures are added one after the other by the same or different artists without regard to preceding figures. The turtle, the predominating figure, was the food of the gods, eaten only by chiefs and keepers of the marae. The figures are sacred symbols and not drawn in the spirit of decorative art, though some idea of embellishment may be present. The petroglyphs discovered in various localities indicate that incising or pecking of figures on stone is almost universal in Polynesia, Samoa being a notable exception.

Siamese Fishes. Mr. Henry W. Fowler describes many new fishes from Siam collected by Mr. Rodolphe Meyer de Schauensee (Zoological Results of the De Schauensee Third Siamese Expedition, Part I.—Fishes. *Proc. Acad. Nat. Sci. Philadelphia*, 86, 1934). Most of the material is from the northern regions, and the results are of much value as a contribution to the ichthyology of Siam. Some fishes from Bali, Dutch East Indies, are also included, obtained from the markets, at the seashore and in fresh waters. In Lake Bratan, Central Bali, which is a small body of fresh water in the crater of an extinct volcano, without visible communication with other waters (elevation 4,040 ft.) fishes were angled with a hook baited with rice, dressed with a sauce, which formed an effective bait. Three handsome new gobies were obtained from south-east and southern Bali. The Siamese collection contains upwards of 4,500 specimens, of which more than half are cyprinoids. There are 50 new species represented by 9 new genera or sub-genera. All these are carefully recorded and described, and the colours noted whenever possible; the whole work is beautifully illustrated.

Marine Fauna of the West Indies. Recent reports of the collections obtained by the first Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep (*Smithsonian Miscellaneous Collections*, 91, Johnson Fund, 1934) are "Three New Deep-water Fishes from the West Indies" by George S. Myers, "New Brachiopods" by G. Arthur Cooper, "Two New Nematodes" by B. G. Chitwood (Nos. 9, 10, 11, Pub. 3238, 3241 and 3243, April) and "Three New Amphipods" by Clarence R. Shoemaker, "New Mollusks of the Family Turritidæ" by Paul Bartsch (Nos. 2, 12, Pub. 3229 and 3246, May, June). In the first, the family Triacanthidæ is revised, Mr. Myers including in it the new genus and species *Johnsonina eriomma*, closely related to *Hollardia hollardi* described by Poey in 1861 from near Havana, but peculiar in having a large eye-like spot under the origin of the dorsal fin. Several rare and interesting brachiopods were collected and a new nematode of special interest was taken from the lizard *Anolis cristatellus*, which appears to belong to a group composed as a rule of parasites of arthropods (*Parathelandros*). Many of the mollusks belong to the Turritidæ, which are very difficult to classify, and it was found that the nuclear characters here, as elsewhere, are useful for systematic purposes. A large number of new species are described and several new genera.

Immature Stages of Scolytidæ. For some years Mr. J. C. M. Gardner of the Forest Research Institute at Dehra Dun, India, has been making a study of immature stages of Indian Coleoptera. Amongst other families his work on the Cerambycidæ has proved of considerable value. In his latest paper ("Immature Stages of Indian Coleoptera" (15), (Scolytidæ), *Ind.*

For. Rec., 20, Pt. 8, Delhi: Manager of Publications, Aug. 15, 1934) he deals with the destructive family the Scolytidæ or so-called bark beetles. As Mr. Gardner says, "the morphology of adult Scolytidæ has been intensively studied but with the exception of studies of a few species, notably by Hopkins (1909), Russo (1926) and Schedl (1931) very little is known of larval and pupal structure". Coleopterists are not yet unanimous on the subject as to whether the description of the adult, however complete, requires to be supplemented by descriptions of the immature stages. Mr. Gardner is, as his work well shows, an advocate of the latter. The grouping of the Scolytidæ, or certain genera in the Scolytidæ, is by no means an agreed matter, and here the assistance of the immature stages might lead to a settlement of certain contested points. The paper in question is an attempt to make a beginning in the classification of Scolytid larvæ. It is restricted to some 17 genera, the larvæ of 25 species being described. The author states that he has not succeeded in finding characters to separate Scolytid larvæ as a whole from those of the Curculionidæ.

Spermatogenesis of the Phasmidæ. Very little has been known of the spermatogenesis of the Phasmidæ. A comparative account by Maurice Favrelle of seven species belonging to as many genera has recently been published ("Recherches sur la Spermatogenèse des Phasmes mâles d'origine bisexuée". Suppt. 17, *Bull. Biol. de France et de Belgique*, 1934). An unpaired X-chromosome is present in each case, the number of chromosomes ranging from 21 to 53 in the different genera. The size of the chromosomes varies inversely with the number, so that the total amount of chromatin remains approximately constant. In *Carausius juvenilis* the X-chromosome frequently divides precociously in the first maturation division, and non-disjunction of the X-chromosomes occasionally takes place in the second division. The spermiogenesis of the group is also described.

A New Parasite in the Blood of Birds. A new protozoan parasite found in the blood of *Leptocoma zeylanica* is described by I. Froilano de Mello and Macario Raimundo (*Proc. Indian Acad. Sciences*, 1, No. 2, 97; 1934). This new species, *Hœmoproteus raymundi*, exhibits a particularly simple schizogonic cycle. Merozoites arise as a result of the nuclear division of free trophozoites, and the former remain free among the cells of the host tissue. They finally attack the red blood corpuscles as schizonts, but no intracellular stage has been detected at any phase of the schizogonic cycle.

Microbiology of the Upper Air. Ever since Pasteur demonstrated the presence of micro-organisms in the atmosphere, bacteriologists have desired to know more about the forms of life which can exist in the higher layers of air. Several attempts have been made to investigate this question, and the results of a recent study appear in the *Proceedings of the American Academy of Arts and Sciences*, 69, No. 8, 315–340 ("The Microbiology of the Upper Air" by Bernard E. Proctor, August 1934). Preliminary tests with Petri dishes exposed from the cabin of an aeroplane indicated the need for an improved collecting apparatus which would reveal the presence of dust and other particles. A current of air, collected by a Venturi tube placed above the upper wing of the aeroplane, was caused to flow through a sterilised filter of oiled paper. This was later examined microscopically and finally used as inoculum for plates of nutrient agar. Forty-five flights were made, and collections obtained at heights up to 20,600 ft. Bacteria and moulds were obtained from the greatest height, whilst yeasts and pollen grains were found above 16,000 ft. The majority of bacteria were the common spore formers of soil and water, and it is interesting, though perhaps not significant, that no pathogenic organisms were obtained. Various species of the genera *Aspergillus* and *Penicillium* were the chief moulds, and 29 species of bacteria have been identified. The results are extensive and carefully tabulated, but show that the microbiology of the atmosphere is constantly changing, and that the factors which control it are not yet fully understood.

Intracellular Inclusions in Plant Virus Diseases. Much interest has centred round the formation of peculiar vacuolate bodies in the cells of plants infected with certain virus diseases. They have been thought to be aggregations of virus particles, but Dr. F. M. L. Sheffield, of the Rothamsted Experimental Station, has shown that they should be regarded as reactions of the host cells to virus infection. In a recent paper ("Experiments Bearing on the Nature of Intracellular Inclusions in Plant Virus Diseases", *Ann. App. Biol.*, 21, No. 3, pp. 430–453, Aug. 1934), she publishes further evidence for this conclusion. Inclusion bodies or X-bodies produced by three distinct diseases have been studied, namely, *Aucuba* mosaic of tomato, *Hyoscymus* III disease, and tobacco mosaic. The last-mentioned virus produces amœba-like bodies which persist for some weeks. Artificial coagulants such as salts of molybdic acid and lactic acid cause the cytoplasm of healthy cells to form small bodies similar to those produced by virus infection. Attempts to inhibit the formation of X-bodies were not successful.

Climatic Changes in Central Asia. A contribution to this much debated problem is made by Messrs. H. de Terra and G. E. Hutchinson in a paper in the *Geographical Journal* of October on the change shown by Tibetan highland lakes. Pangong Tso lies north of the Himalayas at an altitude of 13,915 ft. Built paths along the lake border have been impassable in places for years: the eastern outlet is now considered unfordable: recorded depths have increased: beach lines can be traced below water-level: old alluvial fans on the border have been cut by waves, and lastly, lagoons are traceable to inundation. These and earlier observations dating back fully a century give proof of changes in level. Morari Tso and other lakes in Ladakh also show evidence of recent rises. The chief water supply of these lakes is from glaciers or snow-fed rivers, and it seems obvious to associate the rise in level of the lakes with an increased amount of melting water, or in other words with evidence of glacier retreat. But of this the writers contend there is no sign in recent years and they believe that the cause is one of increased precipitation. The meteorological records at Leh show an increase in precipitation synchronous with the lake rises. This increase has been shown by Dr. C. E. P. Brooks to have been apparent throughout almost all temperate Asia for the thirty years prior to 1910.

The Texas Earthquake of August 16, 1931. Though its greatest observed intensity was not more than 8 of the Rossi-Forel scale, this earthquake affected an area, it is estimated, of 450,000 sq. miles, and was

recorded by the more sensitive instruments in Europe. Prof. Perry Byerly has made a careful study of the seismograms obtained at fifty-four stations (*Bull. Amer. Seis. Soc.*, 24, 81–99, 303–325; 1934). From those at nine neighbouring stations, he finds that the epicentre lay in lat. 30° 53′ N., long. 104° 11′ W., that is, in the Jeff Davis Mountains and close to the continuation of the Apache Mountain fault to the south-east. The travel-time curve of *P* shows a definite break at about 16° from the epicentre, indicating a first-order discontinuity at a depth of about 300 km. Beyond a distance of 75°, the curve has two branches, the upper part of which is interpreted as indicating that the discontinuity at the depth of about 2,400 km. is of the first order, at which the speed of *P* waves drops discontinuously. From the direction of the first motion on the records, it is concluded that the earthquake may have been caused by movement along a fault directed about N. 35° W., upward on the east side and downward on the west.

Vowel Sound Perception. Part 3 of vol. 33 of *Archivio di Fisiologia* contains an account of the measurements made by Messrs. A. Gemelli and G. Pastori of the minimum duration of vowel sounds which allows of their proper perception. By means of an oscillograph, the vibrations produced when words of two syllables like 'nulla', 'mito', 'sasso', 'tonno', etc., were pronounced softly in the ordinary tone of voice by three subjects whose voices had mean pitches of 261, 326 and 480 per second were recorded and analysed. Both curves and analytical tables are reproduced, and include 'open' vowels like the 'a' in 'sasso' and 'close' ones like the 'o'. Although there is some difficulty in allowing for differences which determine the 'musicality' of speaking voices and for the effects of the preceding and following sounds, the authors conclude that the minimum duration of a vowel sound for its proper recognition depends principally on the number of oscillations which take place in the time and to a less extent on the time itself.

Automatic Wilson Chamber for Cosmic Rays. P. M. S. Blackett has published a detailed description of his expansion chamber, which is set off by the simultaneous discharge of two Geiger-Müller tube counters (*Proc. Roy. Soc.*, Sept.). When a fast particle in a gas leaves an ionised track, the latter broadens by diffusion, and in the cloud chamber the ions are immobilised as soon as droplets condense on them. In order to give tracks not broader than 1 mm., the expansion has to be complete within about 0·015 sec. from the passage of the ionising particle. The chamber is designed with a light piston made tight with a rubber diaphragm; the air below this diaphragm is allowed to escape by a valve operated by an electromagnet, which is controlled by the Rossi coincidence counting circuit through a thyratron. Chambers of this type have been operated in a solenoid and in the gap of a large electromagnet.

Heavy Hydrogen. A review of research on the isotopes of hydrogen and on heavy water by L. Farkas has appeared in *Die Naturwissenschaften* (22, 614, 640, 658; 1934). The articles deal with the possible structure of the nucleus of heavy hydrogen, the use of heavy hydrogen in the investigation of the structures of the nuclei of other elements, the spectroscopy of heavy hydrogen, chemical reactions and equilibria in which it plays a part, the ortho- and para-modifications of heavy hydrogen, its physical properties and those of heavy water, the methods of preparation, the determination of heavy hydrogen and a detailed discussion of its reactions. There are numerous literature references. These articles present the most recent data of the subject in a well-classified form.

Ignition Temperatures of Gases. Dr. H. F. Coward (*J. Chem. Soc.*, 1382; 1934) has published the results of a series of experiments made by the late Prof. H. B. Dixon on the ignition temperatures of gases, the method being that of concentric tubes. The supporting atmosphere (air or oxygen) was passed up through a wide porcelain tube, the temperature of which was slowly raised by an electrically heated external platinum spiral. The combustible gas was passed up through a narrow tube, coaxial with the other, terminating in an orifice at the centre of the wider tube. As the temperature rose, a point was reached at which inflammation occurred, and this temperature was recorded by means of a thermocouple just below the orifice of the inner tube. One important result of the work was the discovery that small amounts of nitrogen peroxide in the air or oxygen reduced the ignition points; it was also found that small amounts of iodine in the atmosphere raise the ignition points of hydrogen, carbon monoxide and methane, and that various compounds of bromine raise the ignition point of methane. Dr. Coward, who gives a careful and interesting report of the experiments, discusses the results in the light of current theories. The experiments included the effects of pressure and moisture. The results of determinations in which the effects of hydrogen and of moisture on the ignition of carbon monoxide were examined are particularly interesting.

Electrodeposition of Rubber. Electrodeposition has been proved to be a practical process for the manufacture of many articles including rubber and rubber-coated goods; for example, motor and cycle tubes and rubber-covered screens for sieving coke. A paper by Dr. D. F. Twiss describes the method in technical detail (*J. Inst. Elec. Eng.*, Oct.). Rubber latex consists normally of a suspension of minute negatively charged rubber globules in an aqueous serum. Under electrolytic stress the globules tend to migrate against the electric current. If the current enters by zinc or a porous diaphragm, electrodeposition of the rubber can be effected. Deposits obtained in this way can be dried and vulcanised, and form the basis of several commercial manufacturing processes. The use of latex in this way obviates the need for the heavy machinery used in ordinary rubber manufacture and eliminates the preliminary milling treatment of the raw rubber. This improves the ordinary mechanical properties of the product. In the production of ebonite-coated articles, the current enters the aqueous serum through the article itself, which therefore forms the anode. At present the method can only be used economically for the production of layers less than one centimetre thick. The success of this process in practice is evidence of the advantages arising from its use. On account of the low temperature of vulcanisation, bright organic colours can be used which under ordinary vulcanising conditions would suffer serious discoloration. It is very useful therefore when making upholstery goods.

The Red Sea Biological Station of the University of Egypt

By DR. CYRIL CROSSLAND

THE decision of the University of Egypt to build a biological station in the Red Sea, and the advantages of the site selected at Ghardaqa (Hurghada) have already been discussed in these columns[1]. The station is now in use. Further experience shows that the heat and humidity of the northern part of the Red Sea need not deter visitors whose only free time is the summer vacation. The lower tides and more regular winds make outdoor work easier then, and the temperature of the water is normal for the tropical fauna.

The Anglo-Egyptian Oilfields' steamers communicate with Suez twice a week and supply fresh provisions and water. In consequence, the usual difficulties of desert life are not felt. There is also a post and telegraph office with which the station is connected by telephone.

Every variety of coral reef is to be found within easy reach of the Laboratory. The patches in harbour, 50 yards or less from the Laboratory, are as rich growths as any in the world; outside these are two distinct barriers, the inner of which, if it was formed by coral growth, shows little now and is certainly not extending. They form together with the intervening waters a remarkably rich collecting ground, and there are abundant facilities for practical experimentation on the reefs and their slopes and on the shores.

The station is on a somewhat novel plan, the desert site having several distinct advantages :—

1. The buildings are scattered over a considerable area so that all are open to every breath of wind.

2. The water at the pier-end is as pure as that miles off-shore in temperate seas and for all ordinary purposes filtration is not necessary. To take full advantage of this, the laboratory is placed as near to the sea-water supply as possible, namely, on a pier extending across the shore reef, 150 metres from the beach.

3. There is no general aquarium or central tank room, each worker having a room 5 m. × 5 m., with cement and other tanks.

4. It is no small advantage of the desert site that marks on reefs, cages, etc., put out in the sea, are safe from human disturbance.

The buildings are of wood, with asbestos roofs, as in a maritime climate comfort depends on free movement of air rather than on insulation.

The pier and laboratories are shown in the accompanying illustration (Fig. 1), with the laboratory fleet; namely, two sailing boats and a launch. On the pier end, the thermograph and tide gauge are just visible. Then the little lean-to shed containing the sea-water pump is seen with the small tank above.

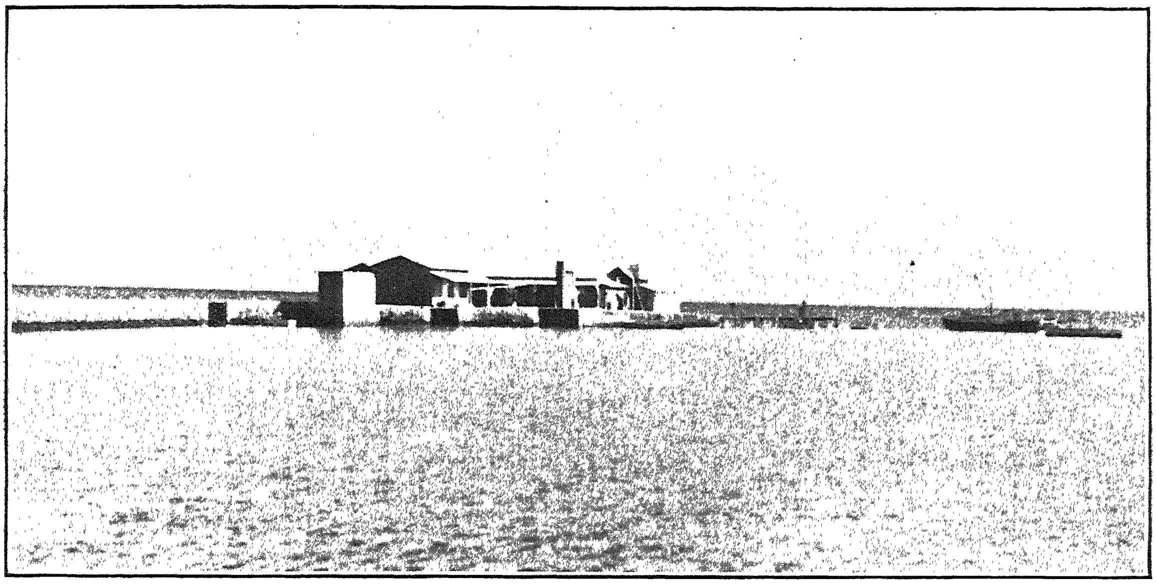


FIG. 1. The Red Sea Biological Station of the University of Egypt.

The long building contains three biological research rooms and one chemical room; the latter, though without concrete tanks, can be used also for biological research, as it has circulating water and a movable aquarium bench. The building in front of the main laboratory combines store and a laboratory for rough work, and in front of this again is a store for fuel for the launch.

Fresh water is brought by boat, from which it is pumped to the small tank on top of the slender masonry tower appearing in front of the laboratory, whence it flows to the main tank on shore. The air compressor is in the lean-to against the end wall of the laboratory.

The buildings at the shoreward end of the pier comprise office, stores, workshops, power house and garages, with bungalows for the staff and visitors. Huts for servants and sailors are at a little distance behind. The station thus takes the form of a village.

Effort has been made to deliver water in the laboratories as little changed as possible from that at the pier head; all the pipes and taps are of celluloid; the pump, electrically driven, is stoneware lined. The concrete tank is as small as possible, its water being renewed two or three times in the 24 hours. This arrangement has proved eminently successful. Corals, some alcyonarians, echinoderms and fish seem able to live in the tanks indefinitely; the huge scarlet nudibranch, *Hexabranchus sanguineus*, *Chromodoris quadricolor*, the gaily coloured *Balistes aculeatus*, the great anemone *Actinia quadricolor* and its active hunter, the bright little fish *Amphiprion bicinctus*, are among the species which have been kept alive for many weeks.

The launch is open, 35 feet long, with 30 H.P. paraffin engine and auxiliary sail as a safeguard. It is fitted with a winch for hauling nets, circulating sea-water pump, hand-winch for water bottles, and a Lucas sounding machine. Of the two sailing boats, the larger brings freshwater from the Oilfields' piers and the smaller is used for fishing. Dredges and trawls of the usual kinds are provided, together with the simpler oceanographical apparatus.

Microscopes and all ordinary glassware and reagents are provided for biological and physiological work and for chemical researches. The library is at present small, but it contains the reports of the principal tropical expeditions, etc., and a series of periodicals.

Applications for accommodation should be made to the Director and should include approximate dates of arrival and departure, the work it is intended to do, and any special arrangements desired. On arrival in Egypt, a telegram should be sent (address Biological Station, Hurghada) on receipt of which the Director will arrange passages from Suez. Living accommodation at the station consists of three small bungalows, simply but comfortably furnished, and a cook is provided.

[1] NATURE, 124, 991, Dec. 27, 1929.

Solid Products of Carbonisation of Coal

DURING the last fifteen years, a flood of publications on the properties of cokes has appeared, much of it scientifically interesting, but uncorrelated with industrial practice. When large-scale processes, for example, the blast furnace, are in question, this is understandable, for conditions are complex and often elude experimental control. Although such difficulties are less evident with small-scale operations, such as the open and closed domestic fires, there is no large volume of published careful experimental work about them. Nevertheless, these publications have shown that the behaviour of a fuel in an open grate can be related to its properties ascertainable in the laboratory. Now a brochure issued by the South Metropolitan Gas Co.* reveals that its chemical staff has been studying this subject for a decade past. It is a comprehensive monograph disclosing a considerable body of work which is, in a large measure, parallel in scope and conclusions with previously published results. The experimental methods used, some of which are novel, will interest students of coke.

Converging evidence detailed points to 700° as the critical temperature dividing 'high' and 'low' temperature carbonisation. The South Metropolitan Gas Co. carries on both types of manufacture, and the experimental work recorded covers both. As few concerns are in this position, the experience recorded is of special importance.

Mention may be made of one test of general interest. A library room was heated on alternate days throughout winter with coal and "Metro-Coalite" in an ordinary grate under the control of the normal occupant of the room. Careful measurements showed that the weight of coal used was the greater in the proportion of 1·37 to 1. This higher efficiency compensates for the greater cost of the "Metro-Coalite", and is a necessary consequence of its lower proportion of volatile matter. The fuel with the higher carbon content has the advantage as a source of radiation, and from this point of view, volatile matter in coal is not merely an objectionable source of smoke, but rather an expensive luxury.

The advantage of high carbon content is greatest with high temperature cokes, and in suitably designed appliances this advantage is being increasingly realised. The South Metropolitan Gas Co. was active in developing grates designed to burn cokes, and experimental work in the subject is recorded. A recent estimate places the number of coke-burning grates sold last year at 69,000. Such a measure of popularity is to be explained by the fact that high efficiency is combined with cheapness of fuel and economy of labour. As the fuel is smokeless, the popularisation of such appliances is an important contribution to public hygiene. H. J. H.

* South Metropolitan Gas Company: Chemical Department. The Solid Products of the Carbonisation of Coal. Pp. 123+4 plates. (London: South Metropolitan Gas Co., 1934.) 3s. 6d. net.

Psychological Needs in Animals

PROF. DAVID KATZ (Rostock) in an address on "Some Problems of the Psychology of Needs" to Section J (Psychology) of the British Association at Aberdeen pointed out that the study of needs seems to be one of the most important tasks of modern psychology. A general view of the whole range of needs (vital, social, artistic and religious) must first be undertaken. Once this has been achieved, two other tasks remain to be investigated: (1) the objects which serve the satisfaction of needs, (2) the methods by which the needs are satisfied. Different needs all reveal the same fundamental laws, but no other need offers, from the point of view of content and method, such a profitable object of investigation as the satisfaction of hunger.

The laws of the satisfaction of hunger reveal the fundamental dynamic relations of all needs, how they are influenced by inner and outer factors and by historical factors which are partly rational and partly irrational. The concept of need may in some fields be more helpful than the concept of instinct,

particularly in such cases where we meet an amazing plasticity in the adaptation of the behaviour to unusual conditions.

By means of a film, Prof. Katz showed the results of investigations on the dissolution of the family in hens. Many factors influence the process of the dissolution of the family. In general, the family lasts so long as a certain physiological state of the hen exists. But in addition to this physiological state, there exist psychological factors which influence the duration of the family group. The hen keeps the chicks the longer the fewer their number, and this irrespective of their size. The dissolution of the family takes place in an active way, the hen actually driving away her chicks. The maternal drive, however, seems to revive again in the presence of danger. The chicks when driven away by the hen keep together for a certain time, forming a gynopædium.

In a second film, Prof. Katz showed the results of interesting experiments carried out on the localisation of sounds by dogs. A dog is trained to run to a small screen behind which a noise, of about half a second's duration, is produced by means of an electric buzzer. Several screens are then placed in a row, the buzzer is sounded, and the dog has to locate the noise by running directly to the appropriate screen. The performances of the dog in locating the noises are amazing. The dog is even successful in distinguishing between two screens when the two are not more than 25 cm. apart, although its own distance from them both at the start is about 5 m. Scarcely any error appears when the dog sits in the centre of a circle of about 10 m. diameter, and 64 screens are distributed at equal distances on the circumference of the circle.

Dr. B. P. Wiesner showed two films demonstrating maternal behaviour in the rat. The studies on these subjects support the point of view of purposive psychology to a considerable extent, but also show that the activities of the animals are not regulated by the achievement of the 'purpose'; many activities are pursued well beyond this point and apparently without relation to field situation or to 'necessity' (*Beduerfnis*). The experiments were extended to a study of the physiological factors underlying maternal behaviour. Observations suggest that the exteroceptors normally engaged in the performance of maternal activities are not necessary for their occurrence but only for their direction. Endocrine factors originating in the pituitary gland (anterior lobe) are probably at the basis of maternal activities. It is possible to produce maternal behaviour in virgin rats by extracts from this gland.

Inversion of *d*-Camphor

In recent years, Messrs. Asahina and Ishidate, of the University of Tokyo, have been engaged in the investigation of derivatives of camphor and have collected some useful data bearing upon the constitution of these compounds. The results are published in the *Berichte der deutschen chemischen Gesellschaft*.

Although the camphor molecule contains two dissimilar asymmetric carbon atoms, it can, by reason of certain limitations imposed upon it by ring-closure, give rise only to two optical isomerides, namely, *d*-camphor and *l*-camphor, both of which are known and are designated as 2-keto-camphane and 6-keto-camphane respectively. Similarly, 3- and 5-keto-camphanes form another optical pair, *l*-epi-camphor and *d*-epi-camphor. Now it has been known since 1914 that each camphor can be transformed into the epi-camphor of opposite sign, but in the August issue of the *Berichte*, Asahina and Ishidate explain how they have been able to effect the conversion of *d*-camphor into *d*-epi-camphor and the latter into *l*-camphor, thus inverting the molecular configuration, but in claiming to be the discoverers of *d*-epi-camphor, they have obviously overlooked the preparation of this substance by Furness and W. H. Perkin in 1914.

The complete cycle of changes as described by the Japanese authors in the inversion of *d*-camphor involves the preparation of 2-5-diketo-camphane from *campherol*, a product of animal metabolism, but, since Bredt and Goeb prepared the same diketone in 1920 by the oxidation of bornyl acetate, derived from *d*-camphor, to acetoxy-camphor and further oxidation of the hydrolysed product, it is obvious that life-processes are not an essential feature of the transformation.

Campherol was characterised as a mixture of at least two and probably four hydroxy-camphors, from which 5-hydroxy-camphor was isolated in the pure condition. On oxidation with chromic acid, this gave 2-5-diketo-camphane, a tautomeric mixture, of which the keto-modification could be stabilised by repeated recrystallisation from acetic acid. Hydrogen cyanide attaches itself exclusively to the 5-keto group of this compound, whereby a new 'asymmetric centre' is developed so that two stereoisomeric hydroxyacids are formed after hydrolysis. Resolution of this mixture is, however, unnecessary, because after reduction of the 2-keto group to methylene, the hydroxyacid group is reoxidised to carbonyl. The resulting product is 5-keto-camphane (*d*-epi-camphor), the configuration of the original asymmetric atoms remaining unaffected. The next step is to oxidise *d*-epi-camphor with selenium dioxide to 5-6-diketo-camphane or *d*-camphorquinone (the optical isomeride of ordinary *l*-camphorquinone from *d*-camphor). Reduction of this compound gives a mixture of 5-hydroxy-6-keto-camphane and 6-hydroxy-5-keto-camphane, the methyl ethers of which can be separated. Further reduction of the former with sodium amalgam gives *l*-camphor (6-keto-camphane), thus completing the inversion.

University and Educational Intelligence

LONDON.—Dr. L. J. Witts, since 1929 assistant physician to Guy's Hospital, has been appointed professor of medicine (St. Bartholomew's Hospital Medical College); Prof. Geoffrey Hadfield, professor of pathology in the University of Bristol, has been appointed professor of pathology (St. Bartholomew's Hospital Medical College). The following appointments have been made in the British Postgraduate Medical School: Mr. A. A. Miles, demonstrator in the Department of Pathology at the University of Cambridge, to be reader in bacteriology; Dr. R. S. Aitken, first assistant to the Medical Unit at the London Hospital, to be reader in medicine; Dr. J. C. Moir, assistant to the Obstetric Unit at University College Hospital, to be reader in obstetrics and gynæcology; Dr. Earl J. King, assistant professor of medical research and director of the Sub-Department

of Biochemistry at the Banting Institute, University of Toronto, to be reader in pathological chemistry; Mr. Lambert Rogers, assistant director of the Surgical Unit at the Cardiff Royal Infirmary, to be reader in surgery.

OXFORD.—In a public lecture delivered at Merton College, Dr. R. T. Gunther, University reader in the history of science, dealt with several names of members of that College who had been distinguished in past times for their scientific achievements. Especially worthy of remembrance were Thomas Bradwardine (born 1290) and Simon Bredon (*c.* 1380); these two, with Mandith (*c.* 1340) and one or two other members of the College, may claim to be the first European authors on trigonometry. In later times, William Merle was the first to keep a meteorological record. Sir Henry Savile (1549–1622), who founded the chairs of geometry and astronomy, was Warden of the College, as also, in 1645, was the great William Harvey.

Science News a Century Ago

Halley at Greenwich

On November 14, 1834, Francis Baily, president of the Royal Astronomical Society, read a paper to the Society entitled "Some Account of the Astronomical Observations made by Dr. Edmund Halley, at the Royal Observatory at Greenwich". He said that Halley was appointed to the post of Astronomer Royal after the death of Flamsteed, on December 31, 1719, and held it until his own death in January 1742, a period of twenty-two years. The instruments used up to 1719 were Flamsteed's property and were removed after his death; and Baily gave some information on the re-equipment of the Observatory. Except for those of the solar eclipse of November 27, 1722, the transit of Mercury of October 29, 1723, and the lunar eclipse of March 15, 1735–6, none of Halley's observations had been published. His other observations from October 1721 until December 1739 were contained in four small quarto volumes preserved at the Observatory. On one occasion, these had been lent to Henderson, and while in his custody had nearly been destroyed by fire. Through the representations of Baily to Capt. Beaufort, however, the Admiralty caused a transcription of their contents to be made. The transcription was in one volume of 518 pages and it was presented to the Royal Astronomical Society.

The Internal Heat of the Earth

The first definite observations on the heat of the earth at considerable depths appear to have been made in 1740 in the lead mines of Giromagny in the Vosges. Later on, observations were made in mines in Germany, Cornwall, Italy, South America and Mexico. All these observations were based upon the temperature of the air in the mines. P. L. A. Cordier and F. Reich in France, however, placed their thermometers in the rock itself. A century ago the matter attracted considerable attention, and a short time after the Edinburgh meeting of the British Association, Prof. John Phillips with others descended the shaft of a coal mine at Monkwearmouth, Durham, where coal was being worked at a depth of 264 fathoms, and made observations on both the temperature of the air and the temperature of the rocks. The observations were made on November 15, 1834, and the results were published in the December issue of the *Philosophical Magazine* in a communication from Phillips entitled: "On Subterranean Temperature, as observed at a Depth of Five Hundred Yards below the level of the Sea in Latitude 54° 55′ North". The augmentation of temperature was stated to be 1° F. for 59·36 feet, or in round numbers, 1° F. for 20 yards.

A Floating Steam Fire Engine

The destruction of the Houses of Parliament by fire on October 16, 1834, had directed attention to the urgent need for improved fire engines on shore and on the River Thames. Steam fire engines for use on shore had already been invented, and in November 15, 1834, the *Mechanics' Magazine* published a letter from W. Baddeley which set out a plan for a self-propelled floating steam fire engine. In his letter, Baddeley said that some years previously he had made suggestions for the improvement of the hand-worked fire float belonging to the London Assurance Company but, he said, "the *ne plus ultra* of fire-extinguishing machinery would be a steam floating fire engine of about thirty horse power. The boat, an iron one, should be built as sharp as possible, and not to draw above ten or twelve inches water. The power of the steam-engine should be capable of being applied to the pumps or the paddles at pleasure. To render such a machine as efficacious as possible, a small fire should be kept constantly burning, so as to keep the water at a temperature of about 100° or 150°."

Toronto Horticultural Society

This Society was established on May 1, 1834. The president is the Hon. George H. Markland. Mr. Knight, Dr. Lindley, Dr. Hooker, and others, are constituted foreign honorary members . . . and all the secretaries of all horticultural societies whatever, corresponding members. Such a Society is likely to do an immense deal of good in a comparatively new country, and we would recommend the secretaries to have their eye on the agricultural exhibitions of the British seedsmen, with a view of procuring from them seeds of improved varieties of grain and other cultivated plants. Implements and machinery may be copied from engravings in books, and modes of culture may be learned from the same source; but seeds and roots cannot be conveyed by pictures or descriptions from one country to another. (*Gardener's Magazine*, November 1834.)

Botanical Collections made by Thomas Drummond

The indefatigable Thomas Drummond, the assistant naturalist in Capt. Sir John Franklin's overland expedition, bids fair to make as valuable botanical collections in the extreme southern territories of the United States as he did in the British possessions in North America. From Louisiana, whence, among other interesting plants, he has added to our gardens the rare *Nuttallia Papaver* and *Sarracenia psittacina*, he has entered the province of Texas; and from the embouchure of the Rio Brazos, and from San Felipe de Austin in the interior, he has sent very valuable despatches, both of the animal and vegetable productions. (Dr. W. J. Hooker in the *Botanical Magazine*, November 1834.)

Societies and Academies

Paris

Academy of Sciences, October 8 (*C.R.*, 199, 649–688). Maurice d'Ocagne: A singular traditional heresy concerning the theory of the endless screw. Paul Montel: Some limitations for the moduli of the zeros of polynomials. David Wolkowitsch: A purely geometrical study of Painvin's complex. G. Polya: Some theorems analogous with Rolle's theorem, connected with certain linear partial differential equations. Pierre Humbert: The symbolical calculus with two variables. Alexandre Ghika: Series of harmonic functions. Michel Luntz: The movement of a perfect fluid round a deformable contour. Théodore Ionescu and Mlle. Ionica Cerkez: An ionised gas rectifier for alternating currents of medium voltage in the magnetic field. Robert Cordonnier: The circular magnetic dichroism of solutions of cuprammonium hydrate and of the corresponding salts (nitrate and sulphate). James Basset and Maurice Dodé: The direct oxidation of iodine and iodides at ultra-pressures. At the optimum temperature (300° C.) with mixtures of oxygen (33 per cent) and nitrogen and at a pressure of 3,600 kgm./cm.^{2} only 2 per cent of iodine pentoxide is formed by the direct oxidation of iodine. With potassium iodide the oxidation is more complete, 40 per cent of potassium iodate being formed at 410° C. Mlle. Marthe Montagne: The constitution and properties of the keto-anils. Louis Chassevent: The formation of definite crystallised compounds at the commencement of the hardening of siliceous cements. Examination by X-rays leads to the conclusion that in the reaction between colloidal silica and solution of lime there is a definite crystallised compound, hydrated monocalcium silicate. Albert Demolon and E. Bastisse: The dispersion of the clay colloids of soils and of sediments. Léon Bertrand and Paul Goby: The Trias and Infralias of the neighbourhood of Grasse and of Bar. Josué Hoffet: The structure of the western Haut-Laos. G. Kempp and J. P. Rothé: The existing phenomena of nivation and accumulation of snow in the Hautes-Vosges. Bernard Trouvelot, Marc Raucourt and Jean Castets: Remarks on the mode of physiological action of the active principles of *Solanum tuberosum* toward the larvæ of *Leptinotarsa decemlineata*. Jean Loiseleur: The chemical phenomena which accompany the resorption of irradiated tissue.

Adelaide

Royal Society of South Australia, April. J. A. Prescott: Single value climatic factors. A critical discussion of a number of proposed climatic ratios involving estimates of rainfall efficiency in terms of rainfall and temperature or saturation deficiency. Evidence is brought forward that saturation deficiency is a good measure of evaporation and that the most satisfactory climatic factor likely to be obtained should include rainfall and saturation deficiency. Conditions for the efficient use of rainfall-temperature ratios involve constant vapour pressure, with the dew point as the zero from which the temperature is to be measured. Maps of Australia are presented giving revised data for the mean annual values for temperature, relative humidity, saturation deficiency, vapour pressure and for the Meyer ratio of rainfall to saturation deficiency. J. Davidson: The monthly precipitation-evaporation ratio in Australia, as determined by saturation deficit. Mean monthly values for saturation deficit have been calculated for a number of meteorological stations in each State of the Commonwealth of Australia, from temperature and relative humidity records. These values have been expressed in terms of evaporation by reference to evaporation records for the respective capital cities. From the information obtained, together with rainfall records, the areas in which the mean rainfall (recorded) exceeds the mean evaporation (calculated) were defined for each month; a map of Australia has been prepared showing the area and months in which rainfall exceeds evaporation as determined by saturation deficit.

Cape Town

Royal Society of South Africa, July 18. Florence Rich: Contributions to our knowledge of the freshwater algæ of Africa. (11) Algæ from a pan in Southern Rhodesia. A collection from a pan at Old Ngamo, five miles north of Ngamo station; it is the first collection from the Rhodesias to be examined systematically and is very rich, especially in desmids. The affinities of the algæ are much more with Central Africa than with South Africa, the general facies being that of a small tropical lake, though this pan dries up more or less completely during the dry season. The collection was made midway through the dry season, and the conditions were evidently very favourable for sexual reproduction, for about fifty species were observed to be in that state. This included twenty-five species of desmids, ten of which were previously known only in the vegetative state. E. Newbery: On a corrosion problem. R. F. Lawrence: New South African Solifugæ.

Sydney

Royal Society of New South Wales, September 5. J. C. Earl and A. W. Mackney: Action of nitrous acid on dimethylaniline (3). The decomposition of *p*-nitroso-dimethylaniline nitrate in glacial acetic acid is submitted to closer study. Operating under controlled conditions, namely, with vigorous stirring at 33° C., the principal product formed has been identified as 2.4-dinitro-dimethylaniline, accompanied by smaller quantities of *p*-nitro-dimethylaniline and *p*-nitrophenyl methyl nitrosamine. The production of nitro and dinitro dimethylaniline is accounted for by the ordinary nitration and oxidation processes to be expected under the conditions employed. The *p*-nitrophenyl methyl nitrosamine, forming in small quantities only, is regarded as a secondary product. Adolph Bolliger: Volumetric micro-determination of ortho-nitrophenols with methylene blue. An alkaline or alkaline earth salt of the ortho-nitrophenol in aqueous solution is transferred to a cylindrical separating funnel containing chloroform. In some instances the free nitrophenol can be used as such. The standardised methylene blue solution is added from a burette and the thiasine phenolate formed is extracted with chloroform. The following were found to be suitable for titration with methylene blue: 2-4 dinitrophenol, 2-6 dinitrophenol, 2-6 dinitro-*p*-cresol, 2-4 dinitro-resorcinol, picric acid, and 2-4 dinitro-naphthol.

Forthcoming Events

[*Lectures marked with an asterisk are open to the public.*]

Sunday, November 11

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Mammals".*

Monday, November 12

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Miss D. Aubertin: "Collecting Insects in Dalmatia".*

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. Harden: "The Chemistry of Fermentation".*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. A. C. Hardy: "Principles and Problems of Pelagic Ecology" (succeeding lectures on November 19 and 26).*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—W. Thesiger: "The Lower Hawash and the Dankali People".

Tuesday, November 13

KING'S COLLEGE, LONDON, at 5.30.—W. Allard: "Canal Headworks—Canals—Drainage—River Training".*

INSTITUTE OF PHYSICS, at 8.—Informal discussion on "Thermostats". Opening speakers: Prof. A. V. Hill, L. G. Carpenter, Dr. J. L. Haughton.*

PHARMACEUTICAL SOCIETY, at 8.30.—Prof. J. B. S. Haldane: "Idiosyncrasies in Men, Animals and Plants".

BRITISH INSTITUTE OF PHILOSOPHY—(at University Hall, 14, Gordon Square, London, W.C.1).—H. W. B. Brown: "The Biological Status of Pleasure".*

ROYAL SOCIETY OF MEDICINE (PSYCHIATRY SECTION), at 8.30.—Dr. David Forsyth: "Psychology and Religion" (Presidential Address).

Wednesday, November 14

BRITISH ACADEMY, at 5.—Prof. A. G. van Hamel: "Aspects of Celtic Mythology" (Sir John Rhŷs Memorial Lecture).

Thursday, November 15

CHEMICAL SOCIETY, at 8.—Discussion on "Chemical Problems in Agricultural Science" to be opened by Sir John Russell.

Friday, November 16

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. H. Freundlich: "The Colloid Chemistry of India-Rubber" (succeeding lectures on November 23 and 30).*

FOURTH INTERNATIONAL CONGRESS OF PHOTOGRAMMETRY, November 16–December 2. To be held in Paris.

Official Publications Received

GREAT BRITAIN AND IRELAND

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1934. (M.O. 368.) Pp. 60. (London: H.M. Stationery Office.)

Birkbeck College (University of London). The Calendar for the Year 1934–35. (112th Session.) Pp. 259. (London.)

South Metropolitan Gas Company: Chemical Department. The Solid Products of the Carbonisation of Coal. Pp. 123+4 plates. (London: South Metropolitan Gas Co.) 3*s*. 6*d*. net.

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 4: Bishop James Kennedy, an Anthropological Study of his Remains. By Dr. David Waterston. Pp. 75–111+10 plates. 8*s*. 6*d*. Vol. 58, Part 1, No. 5: Notes on the Kidston Collection of Fossil Plant Slides. No. 5: On the Structure of Two Lower Carboniferous Lepidodendroid Stems, one of the Lepidophloios Wünschianus Type and the other of the Lepidodendron Fuliginosum Type; No. 6: On the Structure of Two Lepidodendroid Stems from the Carboniferous Flora of Berwickshire. By Dr. Mary G. Calder. Pp. 113–124+2 plates. 2*s*. 3*d*. Vol. 58, Part 1, No. 6: The Feeding Mechanism of the Cumacean Crustacean *Diastylis bradyi*. By Ralph Dennell. Pp. 125–142. 2*s*. 3*d*. Vol. 58, Part 1, No. 7: On the Morphology and Cytology of *Puccinia prostii*, Moug., a Micro-Form with Pycnidia. By Ivan M. (Lamb. Pp. 143–162+2 plates. 3*s*. 3*d*. Vol. 58, Part 1, No. 8: The Metamorphic Rocks of North-East Antrim. By Prof. E. B. Bailey and Dr. W. J. McCallien. Pp. 163–177+2 plates. 3*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Institution of Automobile Engineers: Research and Standardization Committee. Third Annual Report, July 1st, 1933—June 30th, 1934. Pp. 14. (London: Institution of Automobile Engineers.)

Technical Publications of the International Tin Research and Development Council. Series C, No. 2: The Beneficial Use of Tin Compounds in Lubricants. By Dr. E. W. J. Mardles. Pp. 5. Series A, No. 11: A Reflectivity Method for measuring the Tarnishing of Highly-Polished Metals. By L. Kenworthy and J. M. Waldram. Pp. 241–252. (London: International Tin Research and Development Council.)

OTHER COUNTRIES

U.S. Department of the Interior: Geological Survey. Bulletin 850: Quicksilver Deposits of Southwestern Oregon. By Francis G. Wells and Aaron C. Waters. Pp. vi+58+23 plates. 30 cents. Water-Supply Paper 658: The Industrial Utility of Public Water Supplies in the United States, 1932. By W. D. Collins, W. L. Lamar and E. W. Lohr. Pp. iv+135+1 plate. 15 cents. Water-Supply Paper 740: Surface Water Supply of Hawaii, July 1, 1931, to June 30, 1932. Pp. v+121. 10 cents. (Washington, D.C.: Government Printing Office.)

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Vincent, for the Year 1933. Pp. v+30. (Trinidad: Imperial College of Tropical Agriculture.) 6*d*.

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1931. Pp. xiii+191. (Cairo: Government Press.) 40 P.T.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 81: A Comparative Study of *Lolium perenne* and *Phalaris tuberosa* at varying Stages of Growth. By A. B. Cashmore. Pp. 28+4 plates. Bulletin No. 82: The Insect Inhabitants of Carrion; a Study in Animal Ecology. By Mary E. Fuller. Pp. 62+1 plate. Pamphlet No. 48: Field Observations on Weather Stain and Blowfly Strike of Sheep, with Special Reference to Body Strike. By Dr. F. G. Holdaway and C. R. Mulhearn. Pp. 35. (Melbourne: Government Printer.)

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 18: Guide to the Experiment Station, Tanah Rata, Cameron Highlands, Federated Malay States. By E. A. Curtler. Pp. iv+39+4 plates. 50 cents. Annual Report of the Department of Agriculture, S.S. and F.M.S., for the Year 1933. By Dr. H. A. Tempany. Pp. iv+60. (Kuala Lumpur: Department of Agriculture.)

Forest Bulletin No. 86: Cold Weather Planting in Northern India. By H. G. Champion. Pp. iv+16+3 plates. (Delhi: Manager of Publications.) 9 annas; 1*s*.

Instytut Geofizyki i Meteorologji, Uniwersytetu Jana Kazimierza we Lwowie. Komunikaty, Tom. 7, Nr. 80 do 92: Wyników prac Henryka Arctowskiego, i jego współpracowników Adama Kochańskiego, Stefana Kowalskiego, Jana Moniaka, Henryka Orkisza, Wacława Wiszniewskiego i Włodzimierza Zinkiewicza. Pp. iv+370. (Lwów.)

Union of South Africa: Fisheries and Marine Biological Survey. Report No. 11 for the Year ending December 1933. By Dr. Cecil von Bonde. Pp. 88+61+19+18+92+19 plates. (Pretoria: Government Printer.)

National Advisory Committee for Aeronautics. Report No. 486: Infrared Radiation from Explosions in a Spark-Ignition Engine. By Charles F. Marvin, Jr., Frank R. Caldwell and Sydney Steele. Pp. 14. (Washington, D.C.: Government Printing Office.) 10 cents.

U.S. Department of Agriculture. Technical Bulletin No. 427: The Use of Naphthalene against the Japanese Beetle. By Walter E. Fleming and Francis E. Baker. Pp. 28. (Washington, D.C.: Government Printing Office.) 5 cents.

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-sè (Chine). Tome 19: Tables de petites planètes. Par le P. E. de la Villemarqué. Fasc. 1: Dix-sept planètes du type Flora ($1000'' < n < 1100''$). Pp. xi+152. (Sung-Kiang: Observatoire de Zô-sè.)

New Zealand: Department of Scientific and Industrial Research. Eighth Annual Report, 1933–1934. Pp. 73. (Wellington, N.Z.: Government Printer.) 2*s*.

Bulletin of Vanderbilt University, Nashville, Tennessee. Vol. 32, No. 9: Abstracts of Theses. Pp. 84. Vol. 33, No. 9: Abstracts of Theses. Pp. 74. Vol. 34, No. 9: Abstracts of Theses. Pp. 64. (Nashville, Tenn.)

Illinois Biological Monographs. Vol. 13, No. 1: Studies on some Protozoan Parasites of Fishes of Illinois. By Richard Roksabro Kudo. (Contribution from the Zoological Laboratory of the University of Illinois, No. 450.) (University of Illinois Bulletin, Vol. 32, No. 3.) Pp. 44. (Urbana: University of Illinois Press.) 75 cents.

India: Meteorological Department. Meteorological Conditions affecting Aviation over the Northwest Frontier. By Flt.-Lieut. R. G. Veryard and A. K. Roy. Pp. iii+40+5 plates. (Delhi: Manager of Publications.) 1.8 rupees; 2*s*. 6*d*.

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 37, Part 1: The Chemical Investigation of some Gramineae Oils. By Hannemon Ito. Pp. 40. (Tokyo: Maruzen Co., Ltd.)

CATALOGUES

Zoological Preparations: Material for Dissection, Injections and Dissections in Glass Jars, Mounted Specimens in Glass Jars, Cartilaginous Skeletons, Life Histories. Pp. 64. (London: E. Gerrard and Sons.)

Autumn List of New Remainders. (No. 358.) Pp. 46. (Oxford: B. H. Blackwell, Ltd.)

Price List of B.D.H. Laboratory Chemicals. Pp. 190. (London: The British Drug Houses, Ltd.)

Catalogue of Botany and Gardening. (Catalogue No. 227.) Pp. 40. (London: Dulau and Co., Ltd.)

SATURDAY, NOVEMBER 17, 1934

No. 3394 Vol. 134

CONTENTS

A Scientific Approach to Peace

A GROWING volume of uneasiness is evident among men of science as to their responsibilities regarding association with preparations for war. Many scientific workers are conscious of their duties to mankind as a whole as well as their responsibilities to their own nation, and the virulence of economic nationalism in some parts of the world has tended to accentuate their sense of the wider responsibilities; but so far there has been no well-defined professional attitude on the question. The suggestion put before the Technical Committee of the Disarmament Conference that the chemists of the world should include in their code of ethics an undertaking not to work knowingly on the development and production of any prohibited method of warfare, and to expose publicly anyone who was detected in such work, might indeed make secret preparations impossible and render a nation unable to use prohibited methods, because its chemists refused to be associated with the work, but it is chiefly a significant pointer of the growth of scientific opinion on this matter. The matter was also raised at the meeting last summer in Brussels of the International Council of Scientific Unions (see NATURE, July 21, p. 89).

The Bishop of Carlisle, in his British Association sermon at Aberdeen, suggested that the time has come when science should abandon something of that severe spirit of isolation which keeps it aloof from moral inquiries and confines it to the austere analysis of natural events. "Is it," he asked, "to remain content with the provision of antidotes for poisons which it has itself created, or to meet the menace from the air by even more skilfully constructed weapons of defence? Or is it to come down into the arena where men strive and groan to free themselves from perils which are not natural but perversions of the authentic human spirit?"

Beyond this there are indeed others such as Dr. W. A. Noyes, whose part in the reconciliation of German and French chemists after the War is well known, who are seeking to enlist the scientific men of the world in a definite campaign to prevent another and more terrible war.

The suggestion that chemists should combine in refusing to work knowingly on prohibited methods of warfare was, however, commended for consideration by Mr. J. Davidson Pratt in a recent address before the Glasgow Section of the

Society of Chemical Industry. The ethical codes of the medical and legal professions show that it is not impossible for a profession to set up and maintain high ideals of professional conduct, and there is no doubt that a right attitude on the part of the profession of science would be a small but definite help in preventing war.

If the extent of that help can easily be overrated, it is none the less worth having. At present even chemists, the most numerous class of scientific worker, are not sufficiently organised in any country for a definite professional standard to be adopted. The organisation of scientific workers in effective professional associations, and possibly even the legal closure of the profession, may be required before the profession of chemistry or other branch of science could insist that every chemist should give such an undertaking of non-participation under pain of exclusion from the profession.

The first step, however, is the clarification of the conflicting issues and the formulation of a definite opinion and policy. The time is opportune for much wider and freer discussion of the whole question by the professional associations representing every branch of science, and the chapter on "Science and War" contained in Prof. Julian Huxley's recent book "Science and Social Needs" provides an excellent starting point for such a discussion. Most scientific workers would probably accept the realistic attitude which Prof. Huxley adopts regarding the use of science in preparations for war. So long as there is real risk of war, or so long as the possibility remains of nations, through the League of Nations or other institution, being compelled to use armed force against an aggressor nation and violator of international law and order, the fullest resources of science should be used to make warfare as efficient as possible from the military or naval point of view at the lowest possible cost.

This attitude does not, however, as so many are apt to assume at once, give the unqualified support of science to all preparations for war. If we regard research work in connexion with general war needs as legitimate, the general code of the man of science may equally hold that it is illegitimate to undertake research in agencies prohibited by international agreement, or to help in the large-scale production of armaments in peace-time. The acceptance and maintenance of such standards may well become a very important factor, more especially in view of the extent to which industry is passing under the management of those whose outlook is being increasingly influenced by professional standards and ideals.

Discussions on this aspect of the relations between science and war are commonly confused by inability or reluctance to regard the problem of preparation for warfare, and conversely of disarmament, as a whole. The sectional treatment of chemical warfare has dissipated a vast amount of energy that might well have been fruitful had it been applied to the scientific study of disarmament as a single problem. Similarly, no scientific man, any more than any industrialist, however sincere his desire for peace and however firm his belief in world co-operation, can lend his countenance to policies which deliberately encourage inefficiency and the waste of public money, whether on preparations for war or in any other way.

Accepting the view that, while the need for preparations for war remains, these preparations whatever their scale must be as efficient as possible, the scientific worker need find little difficulty in the way in which the general advance of science yields facts and ideas which can be applied to purposes of warfare, any more than in the advantages which industry and society in general have sometimes reaped from research instigated primarily in the service of national defence. He may, however, at times be called upon to point out that the same and much greater results might equally have been achieved by the expenditure of the same effort on deliberate social or industrial investigations. Indeed it is difficult to assess, for example, the advantages which would accrue from the expenditure on investigations on public health of a fraction of our expenditure on war research.

The discussions on the relations between science and war rarely reach this point, and both Prof. Huxley's book and the Bishop of Carlisle's sermon direct attention to the greater possibilities which attend the application of science to the wider field which we here touch. The application of science in the interest of efficiency for war is only the first aspect of the realistic attitude. The application of science to make war as unlikely as possible is equally important, and yet the application of science to the general problem of disarmament has scarcely begun.

The technical aspect of this question has been explained to some extent by Major Lefebure in his book "Scientific Disarmament", but few if any of his suggestions have been taken up, whether by

scientific opinion or the Disarmament Conference itself, a situation which powerfully demonstrates the need for a professional attitude of science on this question. At present, it remains a reproach to the scientific community that it has made no real attempt to secure a real step towards the problem of disarmament by a scientific analysis of the process of armament.

Besides this technical aspect of the study of disarmament, there is a wide field in which the application of scientific methods and of the scientific spirit might do much to eliminate the causes of international friction. The outbreak of national passions which have at the moment largely paralysed disarmament is the natural sequence to our neglect to undertake the scientific study of international relations, and to provide for the impartial and authoritative study of many of the complex international economic and racial problems of to-day. Scientific research on any considerable scale into the causes of war in general, the risks of war in the modern world and the measures to be adopted for reducing those risks, if prosecuted with any vigour on an adequate scale, could not fail to have fostered an atmosphere in which the discussions on technical disarmament would have been much more fruitfully carried on. In its absence, however, the disarmament discussions have necessarily been largely futile.

The very extent of national passions at the present time enhances the need for unprejudiced study of the economic, political and psychological factors making for war. It is only out of such a study that there can emerge the lines of a solution which will command general assent, or influence sufficiently the political outlook and practice to ensure its execution. When, however, Prof. Huxley presents the case for this dispassionate survey, he is only putting into other words the Bishop of Carlisle's plea that science should take the whole of life for its operations, or General Smuts's plea for more of the cool serious spirit of science in human affairs. Already science has largely delineated the external world, and the leading workers in each field know well within what lines the next advance in that field will take place. The plea that science may win even more striking victories for the human spirit, if it regards not only truth but also justice and liberty as equally relevant to its vast concerns, and takes for its subject matter in addition the inner tragedies of the human spirit, cannot lightly be dismissed.

An English Dictionary of Organic Compounds

Dictionary of Organic Compounds: the Constitution and Physical and Chemical Properties of the Principal Carbon Compounds and their Derivatives, together with the Relevant Literature References. Vol. 1: *Abietic Acid—Dypnone.* Editor-in-Chief: Prof. I. M. Heilbron. Pp. xix+706. (London: Eyre and Spottiswoode (Publishers), Ltd., 1934.) 105*s*. net.

EARLY in the present century, it was a comparatively simple matter to ascertain whether a specific organic compound had been described in the literature, and, if so, to determine what was known about it. Time, however, has afflicted operations of this kind with an ever-increasing locomotor ataxy, similar to that which impresses the occasional patron of the London taxi. Indeed, organic chemist and motorist are faced at present with fundamentally similar problems, due to excessive multiplication of the species.

The 1910 edition of Richter's "Lexikon der Kohlenstoff-Verbindungen" contains a systematic record of 144,150 carbon compounds; but organic chemistry has travelled a long way, with continuous acceleration, since 1910. Richter's arrangement is based upon molecular formulæ, and it is a common experience to find a list of thirty or forty isomeric substances arrayed under a particular formula. In his quest of the organic Grail, the modern Galahad who has penetrated the outer defences of Richter is still confronted by numerous sandbagged fortifications in the shape of stout volumes of Stelzner's continuation and the succeeding annual indexes of one or other of the standard series of chemical abstracts; an alternative route leads him into the formidable fastnesses of Beilstein's "Handbuch der organischen Chemie". Issued originally in 1881 in two modest volumes, this encyclopædia of organic compounds—still ironically termed a handbook—has grown into a colossal and excessively costly work, the fourth and unfinished edition of which already embraces nineteen volumes and sixteen supplementary volumes. Even so, this Charlie's Aunt of organic chemistry, in its latest supplements, covers the literature only to 1919.

The perils that do environ the man who meddles with the siren of organic chemistry need no further elaboration. Prof. Heilbron and his collaborators have done much to minimise them, and to conserve the time and energy of the many whose work demands frequent and rapid reference to specific organic compounds. The new work is arranged upon an alphabetical basis, and this method should meet with general approval. In the absence of a universally recognised system of organic nomenclature, the compilers have usually

adopted the most reasonable and obvious names, and there are generous cross-references. Naturally, the dictionary aims neither at the completeness of Richter nor the fullness of Beilstein: by so doing it would sacrifice its chief advantages. It is safe to say, however, that the proportion of organic substances of real importance which has been omitted is remarkably small; the omission of dyestuffs as a class is justified by the existence of the "Colour Index" and other publications.

The full structural formula, when known, is given for each substance: this is a particularly valuable feature. The literature references, which have been selected with judicious restraint, usually guide the inquirer to a description of the best method of preparing the substance. The data for each compound, occupying ordinarily from a couple to a dozen lines, include the molecular formula, molecular weight and common physical constants, besides frequent allusions to functional derivatives. Users of the existing works of reference will welcome most of all the up-to-date character of the dictionary: many of the references in the first volume are so late as 1933, while an addendum (pp. 689–706) refers in certain instances to the literature of 1934, for example, in the entries relating to astacene (a pigment of the Crustacea) and capsanthin (contained in *Capsicum annuum*).

A rough calculation, made on an assumed average of about ten entries per page, indicates that the first volume contains references to nearly 7,000 compounds, excluding the numerous functional derivatives. The dictionary is to be completed in three volumes, the last of which is due in 1936, at an inclusive price of fifteen guineas. It will be a remarkable achievement to cover the whole field of organic chemistry in this short period and at so moderate a cost. The format and production of the work are all that can be desired, the type being particularly easy to read. The publication of this first dictionary of organic compounds in the English language is an event of prime importance to chemists and workers in allied fields of science. Prof. Heilbron, his collaborators, and the publishers have earned the lasting gratitude of all concerned by attacking their monumental task with such enthusiasm, skill and success.

One last thought. In the world of organic chemistry each day is literally 'a bringer of new things'; and now a small cloud of 'heavy hydrogen', no bigger than a man's hand, is taking shape upon the horizon. Could not Prof. Heilbron and his colleagues provide us with some new and ingenious device, modelled perhaps on the card-index, which would guide us in the teeming years to come in our further explorations of 'that untravell'd world, whose margin fades for ever and for ever when we move'? JOHN READ.

Bacteriology and Immunology

(1) *An Outline of Immunity.* By Prof. W. W. C. Topley. Pp. vii+415. (London: Edward Arnold and Co., 1933.) 18*s*. net.

(2) *Streptococci in relation to Man in Health and Disease.* By Dr. Anna W. Williams. Pp. xi+260+8 plates. (London: Baillière, Tindall and Cox, 1932.) 29*s*.

(3) *Bacteriology and Sanitary Science: for Students in Pharmacy, Chemistry and Applied Sciences.* By Prof. Louis Gershenfeld. Second edition, thoroughly revised. Pp. xx+17–493+3 plates. (London: Henry Kimpton, 1934.) 21*s*. net.

(4) *Bacteriology: for Medical Students and Practitioners.* By A. D. Gardner. (Oxford Medical Publications.) Pp. v+276. (London: Oxford University Press, 1933.) 6*s*. net.

(1) THE unassuming title which Prof. Topley has chosen for this new and important addition he has made to the bacteriologist's reference library does less than justice to its scope and the concise yet carefully reasoned treatment devoted to its twenty-one chapters. Though ostensibly for the student, and let us hope, the more advanced student, this individual effort of more than 400 closely printed pages will find a place on the expert's bookshelf alongside another still young arrival of composite authorship, the "Immunity" volume of the "System of Bacteriology" published by the Medical Research Council. Four years ago, Prof. Topley and his colleague, Prof. G. S. Wilson, of the London School of Hygiene, published their "Principles of Bacteriology and Immunity" in two volumes. The pages there given over to immunity problems have been entirely rewritten for incorporation in the "Outline", and these with the addition of much new matter make up the substantial volume now before us.

In recent years there has been considerable activity in many fields of immunology, particularly perhaps in connexion with the constitution of bacterial antigen, the ultimate nature of antigen-antibody reactions and the phenomena associated with local immunity processes. These and many other keenly debated questions of the day are very thoroughly ventilated and expounded in the easy and attractive style which the author commands. He is rarely laboured, his judgments following detailed argument are clear and precise, and when the occasion demands he is not ashamed to say "we do not know".

A most valuable feature of the book is the introduction of summaries at the conclusion of each chapter. These at any rate will be eagerly seized upon by the unfortunate overburdened student seeking a short cut to knowledge in this

field. Moreover, each chapter is provided with ample references to authorities cited. The book does the author great credit, and his colleagues in the bacteriological world are grateful to him for an authoritative exposition of a difficult subject.

(2) Few people are better qualified to write about that vast group of bacteria, the streptococci, than Dr. Anna Williams, for many years the assistant director of the Department of Health Laboratories, New York City, and the colleague of Dr. W. H. Park, who contributes an interesting introduction to her monograph.

The streptococci have always attracted investigators, with the result that the literature on the subject, whether in the current scientific journals or summarised in volumes such as those issued by the Thomsons, is now enormous. Few can spare the time required to study either the papers or the volumes, consequently this monograph, while it cannot pretend to cover the entire field, is most welcome, for it allows one to become reasonably familiar with the problems presented by streptococci in their relation to man, in a reasonable time.

Systematic classification is dealt with, but not unduly stressed. The rôle of streptococci in scarlet fever, rheumatism, erysipelas, puerperal fever and the problems of milk-borne infection are treated with adequate detail. There is even a short chapter on the possible rôle of streptococci in virus diseases.

It is in the last chapter dealing with general considerations concerning our knowledge of streptococci that one realises the difficulties of the task undertaken by the author, for the truth is that from the point of view of the research worker, the streptococci constitute perhaps the most perplexing group of organisms to tackle. On the whole, Miss Williams has given us an admirable presentation of a subject on which the last word will not be said for many days to come. There is an excellent bibliography.

(3) This, the second edition of Gershenfeld's "Bacteriology and Sanitary Science", is designed primarily for the instruction of pharmacists, chemists, nurses, welfare workers and all whose occupation demands for its intelligent performance some knowledge of microbiology in some one or other of its many spheres of practical application. The author, who is professor of bacteriology and hygiene in the Philadelphia College of Pharmacy and Science, gives a succinct but very readable account of bacteria and bacterial economics in a great variety of fields. The scope of the book is, however, much wider than this, and in the 32 chapters into which its 500 pages are divided will be found useful information on a host of topics such as disinfection, fumigation, standardisation of biological products, insect extermination, water purification, sewage disposal, milk hygiene, etc. Immunity also is not forgotten. The book, for the purpose its author has in view, should prove of great value.

(4) There is too little time during the medical course for students to deal adequately with all the subjects of the curriculum. Later on, in practice, this fight against time is even more in evidence. Dr. Gardner's small compendium has been written in an attempt to remedy this state of matters. In addition to providing what all books of the kind hope to do, a short cut, it also aims at lifting the study of bacteriology from the dull subject the student often holds it to be, to the highly intriguing one it really is.

How far students' aids succeed, in the long run, is an open question. If we assume them to have a definitely useful place in the medical student's library, this one should do very well, provided it is adequately supplemented by a sound practical course and a comprehensive set of lectures. It is really doubtful whether any short work on so vast a subject as bacteriology can hope to make the subject alive and interesting.

A James Johnstone Memorial

Lancashire Sea-Fisheries Laboratory. *James Johnstone Memorial Volume.* Pp. x+348. (Liverpool: University Press of Liverpool, 1934.) 21*s.* net.

JOHNSTONE regarded a *Festschrift* as the ideal honour to a scholar, and it is therefore appropriate that this volume of contributions by his friends should be issued in his memory. A biographical note by Prof. F. J. Cole tells us that Johnstone was born in Ayrshire in 1870, became an apprentice woodcarver and a qualified craftsman, and then went with a National scholarship to the Royal College of Science, London, where he came under the influence of Howes. Soon after finishing the course, he was appointed, in 1898, assistant in the Fisheries Laboratory, Liverpool, under Herdman, whom he succeeded in 1920 as professor of oceanography, a post he held until his death in 1932.

The volume is a tribute to Johnstone's many-sided outlook—in zoology, philosophy, fisheries problems, parasitology, oceanography—and to the regard in which he was held at home and abroad, for the contributions are by British, Canadian, American, German, Norwegian, Danish, Russian and Italian writers. It is possible to notice only a few of the twenty-two papers.

Dr. E. S. Russell writes in appreciation of Johnstone's philosophic outlook on biology, basing his remarks on two subjects considered in

Johnstone's last book, "The Essentials of Biology"—the psychobiological unity of the organism, and hence the importance of the study of behaviour and ecology, and the entropy law which he called "the fundamental generalisation of science". H. A. Marmer (U.S. Coast Survey) points out that in English-speaking countries oceanography was until recently focused primarily on biology, but Johnstone in "An Introduction to Oceanography" stressed the geophysical aspects of the subject which may be considered as more or less separate from biology though the marine biologist "will continue to be a powerful ally to the oceanographer".

Prof. W. M. Tattersall and Miss Sheppard contribute an admirable account of the bipinnaria larva of the starfishes *Luidia sarsi* and *L. ciliaris* based on observations of numerous living examples collected in Lough Ine, Cork. The authors state clearly the characters of the respective larvæ; that of *L. sarsi* bears a five-rayed starfish-rudiment and undergoes metamorphosis by shedding the larval ciliated arms, that of *L. ciliaris* has a seven-rayed starfish-rudiment which finally absorbs the larval arms. These larvæ were observed to move, not by ciliary action, but by the rhythmic contraction and extension of the pre-oral lobe. The ciliated grooves of the arms carry food particles close to the mouth into which, when the particles are aggregated into pellets, they are driven. The authors have overlooked Gemmill's short account (1915) of the larvæ of both species from the plankton material of the Irish Fisheries Department.

Prof. F. B. Sumner describes experiments on colour change in fishes. By covering the eyes of *Fundulus* with 'goggles' made of a transparent yellow colour filter, the fish was caused to assume a distinctly yellowish tint identical with that of specimens which had been kept for some hours or days in aquaria with yellow walls and bottom. Writing of the astonishing conformity of the pigment pattern of some flat-fishes to mixed bottoms, Prof. Sumner holds that the only possible interpretation is in terms of concealment.

In a short article, Prof. E. Linton records observations on the helminths of fishes of the Woods Hole region. Prof. W. J. Dakin states that a striking feature of the plankton of the continental shelf of the Pacific coast of Australia is the presence not only of the same genera of plants and animals but also often of the same species as in British seas. Further, the plankton curve of production is strikingly similar to that found for the Irish Sea, but the diatom production does not present such high peaks in spring or autumn.

Prof. A. C. Redfield discusses the proportions of organic derivatives in sea-water and their relation to the composition of the plankton, and Dr. E. Kreps of Leningrad writes of organic catalysts or enzymes in sea-water; he states that in *filtered* water-samples, chemical processes are going on which are generally attributed to micro-organisms, and suggests that a study of the enzymes in sea-water would add greatly to our understanding of the chemical changes in the sea.

Other papers on chemical and physical oceanography include a consideration of the salinity of the surface waters of the ocean, the significance of bottom temperature measurements in relation to the investigation of the deep sea, observations of water movements in the North Sea and in the Straits of Gibraltar and the development of computative methods in relation to the detailed dynamical explanation of the tides in areas of certain defined limits.

The editor, Dr. R. J. Daniel, and publishers deserve commendation for their share in the production of this interesting memorial to one who throughout his life was a keen and independent searcher for truth.

Science and the Modern Highway

(1) *Road Making and Administration.* By Dr. P. E. Spielmann and E. J. Elford. (The Road Makers' Library, Vol. 1.) Pp. x+441. (London: Edward Arnold and Co., 1934.) 25*s.* net.

(2) *Highway Engineering: a Textbook for Students of Civil Engineering.* By John H. Bateman. Second edition. Pp. x+441. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 25*s.* net.

(1) IT is no mere figure of speech to describe this work as one which has been long looked for by municipal and county engineers and their technical staffs, as well as by many members of the general public. Although it is stated that some knowledge of the principles of road construction is desirable in the reader, the ground covered, the clarity of writing and the happy style of phrasing are such as to make the book eminently suited to all those who are interested in this rapidly developing feature of our modern civilisation.

Very little criticism of main outlines need be offered; among minor points, the following were noted:—The section dealing with the planning of highways would have been improved by the addition of a few diagrams; the obviating of slipperiness in asphalt surfacings by the new heat treatment method is only briefly referred to, possibly owing to the fact that it is still more or less in embryo, or on account of Dr. Spielmann's well-founded objections to the application of

excessive heat to bitumens, owing to the risk of damaging them. A misprint seems to have crept in in the last line of page 138; it is thought that the line refers to the new British standard specifications for asphalt surfacings now in course of preparation. The Building Research Station pat test for clinker is not included, while the notes on the slump test for concrete could have been amplified with advantage. The impression obtained from the matter on silicate of soda methods of hardening concrete surfaces does not coincide with the conclusions reached by the Building Research Station thereon. The troubles caused by creeping in rubber blocks, although becoming of historical interest, are not included; the advantages of section 146 of the Public Health Act, 1875, whereby a local authority can get estate roads made up by developers before building takes place, in place of the cumbrous procedure under other Acts, would perhaps have been worth mention.

One of the best sections is that dealing with traffic control, while that on road emulsions is exceptionally clear and complete. It is significant that slag chippings are shown to have almost entirely disappeared under traffic conditions which have left granite chippings still *in situ*.

The photographs are well reproduced, those by the authors being superior to those supplied by firms. Altogether, the work can be described as being by far the best on this important subject yet known to the writer.

(2) Several aspects of road practice peculiar to the United States, such as the construction of earth, shell and sand-clay roads, are dealt with in considerable detail in this treatise, which essays the difficult task of covering the whole field of highway construction in just over 400 pages. One of the distinctive features is the portion dealing with the assessment of benefit derived from road widenings, new arterial roads, etc.; on the other hand, the section on location is disappointingly brief, while that on bridges and culverts, short as it is, would seem to fall within the purview of a complete work thereon.

There is a certain amount of duplication under the heading of superelevation, a well-known formula being stated twice, and the factor of skidding being omitted altogether. The important subject of road intersections is dismissed in a single page, while slipperiness is apparently considered of much less importance in the United States than in Great Britain.

It is not stated whether the book is intended for the use of students, although the sets of problems (answers to which are not given) suggest that its purport is that of a textbook. This being the case, definitions of such terms as water-cement ratio, etc., would have been an advantage, while a fuller explanation of the diagrams would have been helpful.

Tests for aggregates and stone setts are given, but not for such important materials as tar and bitumen; the details of highway plant are fully set out, probably owing to their more extended use in America. B. H. K.

Lions and their Cubs

(1) *Lions, Wild and Friendly: presenting the King of Beasts as a Companion and an Interesting Subject for Photography in his Natural Habitat; the Anecdotes of one who has reared Lions as a Hobby.* By Eric F. V. Wells. Pp. xi+112+32 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1933.) 8*s.* 6*d.* net.

(2) *Engato the Lion Cub.* By J. H. Driberg. Pp. 151+2 plates. (London: George Routledge and Sons, Ltd., 1933.) 3*s.* 6*d.* net.

(1) THE psychology of our pets is our constant study, and the extent of our understanding of the same represents the measure of the success we attain with them. Mammals, being more nearly related to ourselves, particularly attract us, most reacting well to patient endeavour. An occasional person is successful with birds, and now and again we have seen in the East even lizards and snakes made to show affection and go through primitive tricks. Castrated lions and tigers are sometimes seen in Eastern villages wandering about, quite harmless, so long as they are fed. Here we have Mr. and Mrs. Wells visiting the lions in their homes, stealing occasional cubs and rearing them in large enclosures on their veld-farm.

At first the cubs are fed from a bottle, then given a little meat with their milk and finally meat alone, the ration for an adult being about 4,000 lb. a year; not much for a beast weighing about 500 lb. In all, thirty-three lions have been thus reared in nine years, having been taught to take up much the same position in the household as cats and dogs, coming to tea, rolling over and demanding the usual playful attentions and finally expressing their thanks in the usual licks. Regular grooming and cleanliness seem all-important. Always the cub is given a dog as a companion, the two romping together, and the dog, often a terrier, quite safe even when his friend has grown up. "The two amuse each other and the lion is happy" and, when the dog comes to the whistle and is taken for a walk, the cub follows and soon learns.

Of course lions, like Alsatians, are somewhat temperamental, but with owners such as these, who have learnt to read their very expressive faces, they appear to be safe enough. This understanding and an absence of fear has enabled the wild lion packs to be approached, watched and

photographed with great success. We learn much that is unexpected of the intimate habits of very noble beasts, who train their children for their first two or three years in all that pertains to their wild-craft. They are creatures of habit and ordinarily only hunt their legitimate hoofed prey, never learning except by chance that man may be an easier victim. The latter is safe enough in his tree, for the lion is not a climber. It is claimed that he hunts not by scent but by a very acute hearing, while the kill is a highly scientific affair, following a short charge at incredible speed.

(2) In contrast, Mr. Driberg's story is that of the cub he reared with a goat as foster-mother; this was in Kenya, mostly in the Lango country. It is described as kittenish but it soon joined the dogs, obeyed the whistle and even slept under his master's bed. 'Engato' was always a companion on his duty-treks, and we doubt not but that he added to his master's prestige in many a village palaver. The two became inseparable, so that, when one underwent manhood initiation into a Lango society, it was proposed that his associate, 'Engato', should be admitted to "The Lions"; both initiations are described, but, while the master was starved, Engato was allowed to draw upon a private store of meat. Okeng and Lungamoi also tell us some human lore and another story is of a voyage over Kioga, but these good tales must be read in the original.

Origin of Man in America

The American Aborigines: their Origin and Antiquity. A Collection of Papers by Ten Authors assembled and edited by Diamond Jenness. (Published for presentation at the Fifth Pacific Science Congress, Canada, 1933.) Pp. 396. (Toronto: University of Toronto Press; London: Oxford University Press, 1933.) 10*s*. 6*d*. net.

THIS book, sponsored by the National Research Council of Canada, was prepared for presentation to the Fifth Pacific Science Congress, which was to be held in Canada in June 1932, but actually did not meet until June 1933. The editor's preface is dated February 1932, and it must be assumed that these papers were written before that date. The point is not without consequence. The papers are focused on the problem of the antiquity of man and his culture on the American continent, which is considered in the light of the evidence of geology, palæontology, archæology, physical anthropology, linguistics and cultural anthropology. In view of the numerous accessions to archæological knowledge now being made in the United States and Central America, it is important to know precisely what evidence was accessible to the authors when arriving at the conclusions which they have here set down.

On the whole, the views put forward are in agreement that the arrival of man in America was late. As Dr. N. C. Nelson puts it in writing on the archæological evidence, it was "some time after, but probably incidental to the general disruption caused by the last ice retreat". Man is thus made to arrive as "the bearer of the partially developed Neolithic culture somewhere between 5,000 and 10,000 years ago". At most it is conceded that the Folsom stone 'points' from New Mexico may show faint traces of the Solutrean cultural stage. This, it is admitted, is difficult to reconcile with the palæontological evidence, unless the very late survival of extinct fauna be accepted; for notwithstanding much doubtful evidence, the contemporaneity of man and varieties of extinct fauna, especially in the south-western United States, seems well on the way to being established.

On the other hand, the evidence of physical characters is difficult to interpret. Prof. E. A. Hooton, who deals with this topic, shows considerably more caution than some of his colleagues, especially in Europe, in assigning to American Indian strains their Old World affinities. He suggests, very tentatively, that the three dolichocephalic types which he distinguishes point to Mediterranean, negroid and 'archaic white' elements, "subsequently glossed over with mongoloid traits due to mixture with other migrants", and that his three brachycephalic types are derivative from Asiatic Mongoloids. His final view, however, is that the evidence from physical anthropology provides a scheme of research rather than any present contribution to the solution of the problem.

The temptation to follow up the argument as it is set forth in the remaining papers must be resisted. In addition to the topics already mentioned, the geological evidence is discussed by Mr. W. A. Johnston of the Geological Survey of Canada; Dr. Alfred S. Romer of Chicago deals with that of the Pleistocene vertebrates; Dr. Clark Wissler discusses ethnological diversity in America and its significance, and Mr. H. J. Spinden the origin of the civilisation of Central America and Mexico. The late Baron Erland Nordenskiöld deals with the origin of South American civilisation in a thorough manner, which once more emphasises the loss to science through his untimely death. Prof. Franz Boas and Dr. Roland B. Dixon deal with Old World contacts, the former with north-east Asia and the latter across the Pacific. The final contribution is from the editor, who brings his intimate knowledge of the north-west to bear on the difficult problem of the Eskimo.

Short Notices

Traité de Géodésie. Par Capt. P. Tardi. Fasc. 1 : *Généralités sur la géodésie, géodésie mathématique, triangulations.* Pp. xxx+422. 80 francs. Fasc. 2 : *Astronomie géodésique de position, géodésie dynamique, la figure de la terre.* Pp. xi+425–732. 70 francs. (Paris : Gauthier-Villars et Cie, 1934.)

VOL. 1 of this important treatise opens with a succinct historical account as to attempts made to determine the figure of the earth, and goes on to detail the mathematical formulæ on which the more elementary part of the work is based. Methods of calculation of geodetic co-ordinates and of the commoner map projections used in large-scale survey maps are set out in detail. Under the former heading, Roussilhe's method of calculating co-ordinates, developed in recent years, is fully set out, but the Bonne projection, important in France, is but briefly dealt with.

As might be expected, the method of least squares receives full attention, and the value of the volume is very much enhanced by the clearly arranged correction sheets for a primary triangulation.

Vol. 2 deals in greater detail with the determination of the figure of the earth, and gives a full consideration to the mathematical aspect of the finding of latitude, longitude and azimuth, the field work being only treated as incidental thereto. Modern tendencies in the direction of gravity surveys, and a résumé of the geodetic side of isostasy and of theories as to the rigidity of the terrestrial globe conclude the work, which is of a high order. The reviewer does not know any British or American work on geodesy which covers so wide a field in so short a space. It will prove of immense interest to geodesists and to those connected with the mathematical side of Ordnance Survey work. B. H. K.

Modern Home Laundrywork. By E. Henney and J. D. Byett. Pp. x+171. (London : J. M. Dent and Sons, Ltd., 1934.) 3*s.* 6*d.* net.

OUR educational systems have failed to impart the desire on the part of many boys and girls to know about the ordinary things around them ; they are content to drive a motor-car, but not to understand it, to do laundry work and complain of the results equally without understanding. It is true that an increasing number of girls pass through a course of domestic science, and it would be all to the good if a much larger number could be induced to do so, for which purpose much greater facilities for part-time study are required.

This little handbook includes instruction in every process of laundry work from the practical point of view, with just enough science to give a clue to the basis of the treatment advised. Fibres, water, cleansers, are explained ; there is a very practical chapter on stain removal.

We would advocate the presenting of such a book to all girls on leaving school, confident that if they took the trouble to master it, their subsequent path through life would be materially smoothed.

L'Électron magnétique (théorie de Dirac). Par Prof. Louis de Broglie. Pp. viii+315+2 plates. (Paris : Hermann et Cie, 1934.) 100 francs.

IN this book Prof. Louis de Broglie gives an admirable historical introduction to the theory of the spinning electron, starting from the early theories of Bohr and Sommerfeld and exposing all the difficulties which were encountered in connexion with the fine structure and Zeeman effect. He then develops in great detail the theory of the linear wave equation due to Dirac. Dirac's theory is then applied to obtain the fine structure of hydrogen-like atoms and Landé's formula. Finally, the book concludes with a discussion of the problems raised by the existence of states of negative energy.

The mathematical treatment is almost entirely in terms of wave functions and wave operators, the spin operators introduced by Dirac being always taken to have that particular matrix representation which he himself used.

As a result, some of the analysis is rather lengthy, and could have been considerably simplified by the use of operational methods. However, there are many workers in this field who will find it extremely convenient to have a book which sets out in full the wave mechanical aspect of Dirac's theory. There are certain omissions from the book, notably Mott's theory of scattering and the recent theoretical speculations of Eddington. G. T.

The Subject Index to Periodicals, 1933. Issued by the Library Association. Pp. x+273. (London : Library Association, 1934.) 70*s.*

GREAT credit is due to the editor, Mr. T. Rowland Powel, his staff and the voluntary contributors for a further speeding up of the publication of the annual volumes of this subject index. This year, the volume for 1933 appeared only eight months after the end of that year. Although these subject indexes have a permanent value as a record of published work, it is obvious that those who are engaged in investigations will wish to have the work of others in the same field brought to their notice as soon as possible.

The present volume comprises entries of more than 25,000 articles, selected from periodicals of which a list is given. Of these periodicals, no less than 539 are English and American, but 41 are French, Belgian, Swiss, German and Italian publications. It should, however, be noted that the indexing of English and American periodicals is not complete, because, with few exceptions, no attempt has been made to index periodicals covered by the following publications : *Agricultural Index, Engineering Abstracts, Engineering Index, Index Medicus, Journal of the Society of Dyers and Colorists, Photographic Abstracts, Revue de Géologie, Minéralogie et Crystallographie,* Royal Meteorological Society's *Bibliography, Science Abstracts* and *Journal of the Textile Institute.* A wide range of subjects has been selected for indexing, but verse and fiction are excluded.

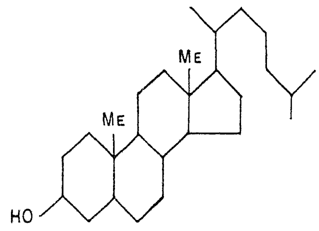
Recent Progress in the Chemistry of the Sex Hormones

By Dr. J. W. Cook

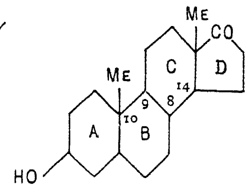
THE conversion of cholesterol into the male sex hormone (androsterone)[1], already noted in these columns[2], with its attendant elucidation of the complete chemical structure of this hormone, provides a convenient point at which to review the present state of chemical knowledge of the sex hormones.

Stimulated by secretions of the anterior lobe of the pituitary, the gonads (testis, ovary) secrete substances which control the growth and development of the organs of reproduction, and excite the secondary sexual characteristics. There are many biological tests with castrated male mammals, birds and fishes by which the presence of such substances in testicular extracts may be recognised, as has long been known. Similar active extracts may be prepared from the urine of males, and in 1931 Butenandt and Tscherning[3] isolated four crystalline substances from oily extracts prepared from 100,000 litres of such urine. One of these, when injected in minute doses, produced growth of the undeveloped comb of the capon. The measurement of the extent of such growth, resulting from injections made under exactly defined conditions, gives a quantitative test for the male hormone[4], and is the only biological test which had hitherto been applied to the pure crystalline active substance (now known as androsterone). Thus it has not been possible to ascertain if the manifold effects of testicular extracts on male organs are due to one or to several substances. Now that Ruzicka[1] has achieved the artificial preparation of androsterone, it will be available in sufficient quantity to make a complete biological study of its effects, and such questions will doubtless soon be answered. Indeed, it is reported already that the artificial hormone had very definite regenerative action on the accessory male organs (seminal vesicles, prostate and penis) of castrated male rats.

The immense difficulty of isolation of appreciable amounts of androsterone from urine, due not only to the very small concentration, but also to the presence of chemically related inactive substances, has precluded any attempt to study the molecular structure by means of degradative reactions. Nevertheless, Butenandt was able to characterise the substance as a saturated hydroxy-ketone of the probable formula $C_{19}H_{30}O_2$, and to prepare a number of functional derivatives such as the oxime, acetate, etc. On the assumption of a relationship to the sterols and to œstrin, the structure (II) was suggested for androsterone. This structure has been completely verified by Ruzicka's isolation of androsterone from the neutral products of the chromic acid oxidation of the acetate of *epi*dihydrocholesterol (I):—



I



II

Of the 128 stereoisomerides of (II) which are theoretically possible, four were prepared by Ruzicka. The configurations of these are naturally those of the sterols from which they were formed by oxidation. These sterols were dihydrocholesterol, *epi*dihydrocholesterol (both have *trans* configurations of rings *A* and *B*, but differ in the spatial positions of the hydroxyl group), coprosterol and *epi*coprosterol (both of these have *cis* configurations of rings *A* and *B*).*

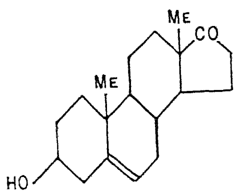
The remarkably specific action of the hormone was shown by the fact that the two *cis* hydroxy-ketones (II) were without action on comb growth in doses about fifteen times as large as that of androsterone which sufficed for a 20 per cent increase in area of the comb. By contrast, it may be recalled that the biological activities of œstrin may be reproduced by a whole series of artificial compounds differing appreciably in structure from the natural hormone[5].

Great interest attaches to the biogenetic implications of Ruzicka's experiments. The hypothesis that androsterone is an ultimate product of biological degradation of the side chain of cholesterol, passing through the intermediate phases of lithocholic acid and pregnandiol, is no longer tenable, for lithocholic acid and pregnandiol both belong to the coprostane (*allo*cholestane) series, whereas androsterone is shown to be related stereochemically to *epi*dihydrocholesterol. In this connexion, Ruzicka records in a footnote an experiment with lithocholic acid which shows that the bile acids belong to the *epi*coprosterol series. Ruzicka suggests that the biological conversion of cholesterol into androsterone proceeds through the same stages as the transformation *in vitro*, that is, reduction to dihydrocholesterol, epimerisation of

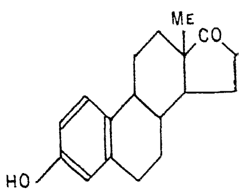
* The formulations used by Ruzicka to represent the configurations of these sterols and their derivatives are open to criticism on the ground that they assign definite configurations to rings *A* and *C* with respect to carbon atoms C_9 and C_{10}, and to rings *B* and *D* with respect to C_8 and C_{14}. No information bearing on these questions is at present available.

the hydroxyl group, and then oxidative fission of the side chain. It seems to the present writer that the dehydroandrosterone isolated from urine by Butenandt[6] should be considered in this connexion. This is an unsaturated hydroxyketone which can be hydrogenated catalytically to androsterone. If the double bond of dehydroandrosterone is in the position suggested by Butenandt (III), then this substance rather than dihydrocholesterol may be the intermediate in the natural formation of androsterone. The fact that the configurations of rings *B*, *C* and *D* of androsterone are identical with those of the corresponding rings of the sterols and bile acids is a strong argument against the view that the hormone is synthesised by the body independently of cholesterol.

Dehydrogenation of ring *A* of androsterone, with loss of the methyl group at C_{10}, would lead to structure (IV), which is the formula at present favoured for the principal œstrus-producing hormone, œstrone. Developments in the chemistry of this hormone are too well known to require more than a passing reference here[7]. The demonstration of the presence of the phenanthrene ring system[8] and the proof that the complete ring system is that of cholesterol with the hydroxyl group in the same position[9] lend strong support to structure (IV) for œstrone, but it must be emphasised that experimental proof of the position of the carbonyl group is lacking, except that it is known to be in the five-membered ring. Also, nothing is known concerning the configuration of the ring system of œstrone (sixteen stereoisomerides of (IV) are theoretically possible).

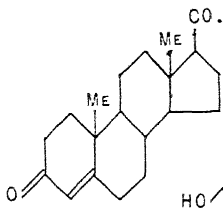


III

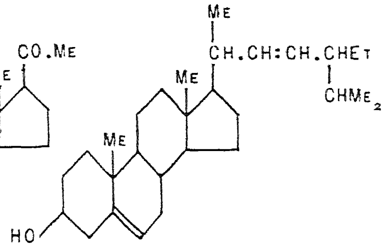


IV

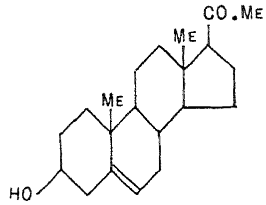
Together with its other physiological effects, œstrin is responsible for the œstrous phenomena of the lower mammals, and probably also for the reparative changes of the uterine endometrium during the first half of the post-menstrual period in primates. Closely bound up with œstrin in its action is the hormone secreted by the corpus luteum, an organ formed normally by development of the ruptured follicle after expulsion of the ovum. The corpus luteum hormone (also known as progestin) exerts a specific proliferative action on the uterine endometrium, and prepares the uterus for implantation of the fertilised ovum. Moreover, actively secreting corpora lutea (or suitable extracts) must be present during the phenomenon of pseudo-pregnancy which occurs in the lower animals (mouse, rat, rabbit, dog); in some species (for example, the rabbit, but not the primates) the presence of progestin is necessary for the maintenance of pregnancy. It is believed that œstrin and the corpus luteum hormone, acting in conjunction, are responsible for the menstrual cycle in the human species.



V



VI



VII

The pure corpus luteum hormone has recently been isolated from corpus luteum extracts by three groups of workers[10,11,12]. As with the male hormone, isolation of the active principle is complicated by the accompanying inactive substances of similar chemical nature, and there was at first some difference of opinion regarding the physical characteristics of the pure hormone. All three groups of workers are now agreed that the principal hormone is an unsaturated diketone of m.p. 128°, and they have also isolated a second substance of m.p. 118°–120°, which Slotta and his collaborators find also to have the biological activity of the hormone. The second substance is converted by heat into the hormone, m.p. 128°, and the two active substances are regarded by Slotta as stereoisomerides (the suggested stereoisomeric forms are, in fact, identical if his postulated formula is correct). On the assumption that this hormone also is derived from the sterols, its composition and properties suggest that it is an unsaturated derivative of pregnandione, that is, of the diketone arising from the oxidation of pregnandiol, a physiologically inactive substance first isolated by Marrian[13] from urine of pregnancy, and shown by Butenandt[14] to belong to the cholane series. Slotta, Ruschig and Fels attribute structure (V) to the corpus luteum hormone, the position assigned to the double bond depending on spectroscopic evidence, which suggests an αβ-unsaturated ketone. Evidence in favour of this view is afforded by the

degradation of the side chain of stigmasterol (VI)* to a substance having corpus luteum hormone activity[15]. Adopting the technique of Fernholz[16], Butenandt and his collaborators converted stigmasterol into a hydroxy-bisnorcholenic acid (VI; but with side chain degraded to $-$ CHMe.CO_2H). By a further series of changes this acid was converted into the hydroxyketone (VII), which on mild oxidation gave a mixture of substances. The lowest melting fraction from the mixture (m.p. 129°–135°) had corpus luteum hormone activity in doses only slightly greater than those required with the pure hormone. The report of the isolation of a chemically pure substance from this mixture will be awaited with interest. It may well be that the day is not far distant when the three sex hormones (androsterone and progestin as well as œstrin) will be available for clinical use in chemically pure crystalline form.

* It should be observed that the positions assigned to the hydroxyl group and the nuclear double bond of stigmasterol are based on analogy with cholesterol; there is no experimental justification for this assumption.

[1] Ruzicka, Goldberg, Meyer, Brüngger and Eichenberger, *Helv. Chim. Acta*, **17**, 1389, 1395; 1934.
[2] NATURE, **134**, 563, Oct. 13, 1934.
[3] Butenandt and Tscherning, *Z. angew. Chem.*, 905; 1931. A review of investigations on the testicular hormone is given by Tscherning, *Ergebnisse der Physiologie*, **35**, 301; 1933. See also reference (6).
[4] Schoeller and Gehrke, *Wien. Arch. inn. Med.*, **21**, 329; 1931.
[5] Cook, Dodds, Hewett and Lawson, *Proc. Roy. Soc.*, B, **114**, 272; 1934.
[6] Butenandt, *Wien. Klin. Wochschr.*, **47**, 936; 1934. *Forschungen und Fortschritte*, **10**, 266, 276; 1934.
[7] A review, with bibliography, is given by Störmer and Westphal, *Ergebnisse der Physiologie*, **35**, 318; 1933.
[8] Butenandt, Weidlich and Thompson, *Ber.*, **66**, 601; 1933.
[9] Cohen, Cook, Hewett and Girard, *J. Chem. Soc.*, 653; 1934.
[10] Butenandt, Westphal and Hohlweg, *Z. physiol. Chem.*, **227**, 84; 1934.
[11] Slotta, Ruschig and Fels, *Ber.*, **67**, 1270, 1624; 1934.
[12] Hartmann and Wettstein, *Helv. Chim. Acta.*, **17**, 878, 1365; 1934.
[13] Marrian, *Biochem. J.*, **23**, 1090; 1929.
[14] Butenandt, *Ber.*, **63**, 659; 1930. **64**, 2529; 1931.
[15] Butenandt, Westphal and Cobler, *Ber.*, **67**, 1611; 1934.
[16] Fernholz, *Annalen*, **507**, 128; 1933.

Use and Origin of *Yerba Maté**

By CAPT. T. A. JOYCE, O.B.E.

THE origin of the practice of infusing the leaves of the ilex is very obscure. The earliest mention of the drink I have quoted is from Nicholás Durán (1626–27). By that time, as the extract shows, the beverage had spread far and wide through South America. But there is no account of its discovery. Pinelo, writing in 1636, refers to an author, Robles Cornejo, where he says a full account of the herb is given. Cornejo's work, "Examen de los Simples Medicinales", dated 1617, must contain the first reference to the drink. But the book existed only in manuscript and, though mentioned in Cejador y Franca's "Historia de la Lengua y Literatura Castellaña", has absolutely disappeared.

So far, evidence would seem to show that the drink was a native discovery, developed by the Jesuits; but a study of the early history of the country provides another aspect. The Rio de la Plata was discovered by Juan Diaz de Solis in 1516. In 1534, an expedition was sent from Spain under Pedro de Mendoza to make permanent occupation of the country to the north. With him sailed Ulrich Schmidt, or Schmiedel, as he was called by the Spaniards, a Bavarian agent of merchants in Seville. He ascended the Paraná and Paraguay with the pioneer expeditions and made many journeys of exploration through the heart of the Guaraní country, finally making a cross-country journey of some hundred and thirty miles from the upper Paraná to São Vicente; then he returned to Europe after an absence of nearly twenty years.

Schmidt's reminiscences are remarkable from several points of view, and perhaps especially for the accuracy of his memory and the almost incredible vileness of his orthography in dealing with Spanish and Indian words. His narrative is of great importance to anthropology, because it is the report of a pioneer and an observer. Whatever he may have forgotten, his mind is extraordinarily clear on the food question. He writes in detail what he had to drink and eat and where, day by day. Naturally, food was very important, and these European expeditions, living on the country, were often on the verge of starvation. For days they had to pass through unoccupied country, and their minds were naturally focused on the food quest. Schmidt tells how the Carios make 'wine' of Mandepore (manioc) and of honey; the Mbaia and Payagua, of 'fenugreek'; the Guyacurú, of the algarroba bean. But in none of his copious food notes does he ever make mention in his twenty years' experience of the use of the ilex leaf either chewed or infused.

During the period of Schmidt's residence in Paraguay, Cabeza de Vaca was sent to the country as Adelantado. From São Francisco, in the far south of Brazil, where he landed, he made a remarkable overland journey to the newly founded settlement of Asunción, passing through the heart of the country where the ilex grew naturally. In the course of his three years' residence he made several journeys northward. His narrative (1555) is full of details of considerable ethnographical importance and, though he pays less attention to local foodstuffs than Schmidt, the precarious nature of his supplies led him to record much useful information on this subject. Yet in his account there is no mention of the ilex.

* *Continued from p.* 724.

Between 1569 and 1574, Nicholas Monardes published a work entitled "Las cosas que se traen de nuestras Indias occidentales", translated into English in 1580 under the far more attractive title "Joyfull Newes of the New-found World". He gives an extended and delightful description of the properties of coca, tobacco and many other American products, but there is no mention of *yerba maté*.

Diaz de Guzman (1612) gives a descriptive account of practically the whole region occupied by the Spanish east of the Andes in his "Historia Argentina" (Paraguay did not become a separate province until 1620), but there is no mention in his pages of the 'herb of Paraguay'. Thus the first reference to the use of the ilex leaf does not occur in literature until more than ninety years after Schmidt entered the country, eighty-five years after Cabeza de Vaca passed through the forests which later became the principal source of supply, and more than half a century after Monardes had published his series of monographs on the economic contribution made by the newly discovered Americas to the Old World. The lost MS. of Cornejo might supply the information as to the origin of the commercial use of the 'herb'. But the inference is, on the evidence, that the leaf was not in general use by the natives prior to the establishment of the Jesuit missions, except, perhaps, for chewing.

The native name of the dried leaf gives little help. In the Guaraní dialect the principal varieties were known as *Caamini* and *Caaguazú* (in Brazil, *Congonha*).

The tree itself was known as 'caa', which simply means a tree, a generic term, and it is easy to produce parallels from other native dialects that no plant of importance is mentioned except by a specific name. The implication is that, as far as the natives were concerned, the ilex was merely a tree.

It has been suggested that the word 'caa' bears some relation to the Chinese 'c'ha', meaning tea in the Pekinese, Mandarin and Cantonese dialects. Tea was first brought to Europe by the Dutch in the early seventeenth century from Bantam, whither it had been imported by Chinese merchants from Amoy, where it was called 'té'. The Portuguese found it in Macao, under the name 'c'ha', a little later. The first mention of tea in Western literature is in Maffei's "Historica Indica", published in 1558. It is not inconceivable that the Jesuits of the period, looking for a substitute for tea, by then introduced into southern Europe, also introduced the Chinese word, which was mispronounced by the natives.

The subsequent development of the *yerbales*, or ilex plantations, is a matter of history. The economic importance of the leaf, combined with the fact that it grew in the less accessible regions (swampy mountain valleys), soon led to the inception of attempts to bring it under cultivation. Rodero gives the account of the first attempt.

Young trees were brought from Maracayu to the mission communities along the Paraná river, but did not flourish. Experiments in raising seedlings were also a failure. The eventual success is recorded by Dobrizhoffer (1749), who reports that the seed of the ilex is covered with a thick coating of gluten which prevents germination. In the wild state, this gluten is removed by passage through the bodies of certain birds, principally the South American pheasant (jacu). This gluten was eventually removed by careful washing and the seed sown deep in ground drenched with water. The young seedlings were planted out in deep trenches under thatched shelters. Yet, even after these precautions, the cultivated plants never attained the size of those growing under natural conditions. However, the "Handbook of Paraguay" (1894) states that the Jesuit attempts were so successful that at Santiago (Paraguay) there once existed a grove of 20,000 trees. On the expulsion of the Jesuits, these plantations disappeared, and only in recent years have successful *yerbales* been established in the Misiones territory of north-eastern Argentina.

The ilex tree remained without any name assigned by international botanists until the nineteenth century; and it was by a curious piece of bad luck that the famous French botanist, Dr. Bonpland, was prevented from having the honour of classifying *yerba maté*. Bonpland went, in the year 1820, up-river from Buenos Ayres to Paraguay, with the object of obtaining specimens of the plant; but Paraguay, always isolated, was under the dictatorship of that extraordinary individual José Gaspar Francia, whose policy put a fence round the little country. Bonpland was placed under a kind of arrest, detained for many years, and while he was still practically a prisoner of Francia's, *yerba maté* had been seen by Saint Hilaire in South Brazil, in the Curityba region, identified as a member of the ilex family, and named by him *Ilex paraguariensis*. Saint Hilaire afterwards changed the name to *Ilex maté*; but meanwhile, in 1824, A. B. Lambert, the distinguished English botanist, described the tree, illustrated it, and gave it the name *Ilex paraguayensis*, by which it is now usually known.

The subject with which I have been dealing may seem, at first sight, to be a little removed from anthropological studies; but I would suggest that the study of ethno-botany is of the highest importance. The rapid spread of stimulants, narcotics and food plants throughout the world has a direct bearing on culture-diffusion. But trouble arises

from the fact that valuable food plants spread so rapidly that their origin becomes obscured—especially cereals. Maize, to give one example, indigenous to America and unknown in the Old World before Columbus, became the staple food of half Africa within a century of the discovery, spreading from tribe to tribe, far beyond European exploration. In Europe it penetrated to the Levant, and became known in France as *blé de Turquie*. In Germany it was called *türkische Weisen*. In England it was called guinea corn, because it came to us from West Africa. I suggest that there is a splendid opportunity for a young man, trained in botany, to undertake the revision of that fine work "The Origin of Cultivated Plants" written by Alphonse de Candolle. The last edition of this was published in 1909, but the preface, written in 1882, is a model of sympathetic guidance to those who follow. Much has been discovered since de Candolle's day, and a new edition is badly needed. I hope that some of the younger men may take up the task.

A Marsupial Sabre-toothed Tiger from South America*

THE marsupial or pouched mammals of Australia are well known to include groups which are parallel in form and habits to many groups of the higher mammals living in the rest of the world. The pouched mammals of South America, both past and present, are less varied and represent only insect-eaters and flesh-eaters. Among the latter, however, Dr. Elmer S. Riggs has just described perhaps the most remarkable mimic of a higher mammal hitherto discovered. In a Pliocene deposit in Catamarca, northern Argentina, he has found the remains of a pouched mammal which nearly resembles the familiar Machærodonts or 'sabre-toothed tigers', but is clearly inferior in the less efficient adaptations of its skeleton to its mode of life.

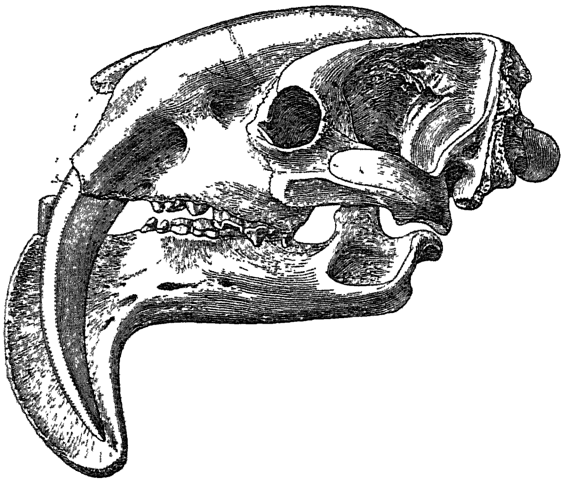


FIG. 1. Side view of skull of *Thylacosmilus atrox*. Holotype No. P 14531 Field Museum. Reproduced from *Field Mus. Geol. Ser.*, 6, 61, Dec 11, 1933.

Of *Thylacosmilus*, as Dr. Riggs names the new mammal, most parts of the skeleton are now in the Field Museum of Natural History, Chicago. The skull, which is shown in side view in Fig. 1, measures from 8 to 10 inches in length, according to the species; and the head and trunk would have about the same relative proportions as in a leopard. The great canine tusks differ from those of the ordinary sabre-tooths in having an open pulp-cavity enabling them to grow throughout life; and the maxillary bones which enclose their roots grow upwards and backwards over the fore-head to accommodate them. These tusks are not quite sabre-shaped, being flattened triangular in section, and the enamel which only incompletely covers them is very thin. They are very feebly and finely serrated on the edge. There are no incisor teeth, and the molars and premolars are as small and inefficient for cutting flesh as those of their contemporary relatives, the Borhyænidæ—very different from the powerful corresponding teeth of the true sabre-tooths. There is a bony post-orbital bar, evidently to strengthen the side of the skull; and the back of the head is shaped for the insertion of strong neck-muscles. The lower jaw is remarkable for the large size of the pair of bony flanges which protect the tips of the canine tusks. They are larger than those in any of the sabre-tooths.

The hinge of the lower jaw on the skull, however, is almost exactly as in the sabre-tooths, and the mouth could be opened as widely as in them to allow the tips of the tusks to be used. The neck vertebræ are large and strong for the origin of the powerful neck muscles which would be needed for the thrusting of the tusks. The feet, however, are astonishingly different from those of the sabre-tooths, for they bear only pointed toes, not grasping claws.

As Dr. Riggs points out, the discovery of *Thylacosmilus* is all the more remarkable because among the numerous fossil mammals known from the older Tertiary rocks of Argentina there are no recognisable ancestors in which the canines are gradually enlarging. It shows that the deposits hitherto explored contain only an imperfect record of the extinct mammal fauna, and that much may be expected from future discoveries. A. S. W.

* Elmer S. Riggs, "A new Marsupial Saber-tooth from the Pliocene of Argentina, and its Relationships to other South American Predacious Marsupials" (*Trans. Amer. Phil. Soc.*, n.s., **24**, pt. 1; 1934).

Meteorology in India

THE report on the Administration of the Meteorological Department of the Government of India in 1932–33 (Delhi: Manager of Publications, 1933. 12 annas; 1*s*. 3*d*.) includes an account of internal adjustments made, in the face of a cut of more than twenty-five per cent in the Department's budget, with the view of providing meteorological information for aviation. The Administration had to meet, so far as was practicable, increasing demands for forecasts and warnings due to extensions of the aerial passenger and mail services. The situation revealed by the report is such that it can only be hoped that less difficult financial times will very soon lead to its improvement; about 4,000 miles of the main international air route has to be dealt with by the meteorological centres at Karachi and Calcutta, now that the offices at Delhi and Rangoon have been abolished, and with the staff available only two daily forecasts have been possible, one at noon and one at 8 p.m., and the preparation of special weather charts during disturbed weather has been greatly curtailed.

Partially to compensate for this, auxiliary centres have been established at landing places on the main route, in charge of meteorological assistants, and a scheme for increasing the frequency of weather reports throughout the whole weather report system has been drawn up with a view to its early introduction. It is satisfactory to note that other branches of applied meteorology have not been neglected, the services rendered to the public and to public bodies having actually increased. Valuable assistance was rendered to the Everest flight and expedition; the exploration of the upper atmosphere by sounding balloons carrying meteorological instruments has been continued, a large number of records having been obtained which extend into the stratosphere; the section for agricultural meteorology organised a model observatory at an agricultural college with the view of providing facilities for agricultural workers requiring training in the study of weather in relation to crops, and in addition a number of special pieces of research work have been carried out and the results published.

The Meteorological Office at Poona is situated between two rivers. Katabatic winds develop in the river valleys at night under certain conditions and may overcome the normal wind drift due to the general pressure gradient over the west of India. A study of the dust haze and fogs that develop at night over the city in the cold season and of these conflicting winds—that have an important bearing on fog formation—has been attempted recently, the upper limit of the obscurity being determined either photographically—on moonlight nights—or with the aid of a searchlight and theodolite. The observations were made by L. A. Ramdas and S. Atmanathan and are discussed and illustrated in some detail in *Scientific Notes*, vol. 5, No. 54, of the India Meteorological Department. The establishment of inversions of temperature after sunset and their break-up after sunrise is demonstrated by readings of temperature made on the tower of the Meteorological Office with an Assmann ventilated thermometer between ground level and a height of 34·5 metres.

The visual and photographic studies towards the end of the paper on the behaviour of the top of the haze or fog at the time of its dispersal are perhaps the most valuable portion, especially those showing the effect of a katabatic wind from the south-west, which may be to remove the top part of the haze so as to leave a sloping upper surface at the same time that the whole area of haze is displaced towards the north-east. At an early stage of the dispersal of fog by sunshine, distinct cumulus clouds were sometimes observed to result from the breaking up of the top layers, but at a later stage the fog boundary became very blurred at the same time that it extended upwards, under the action of turbulence, the distant hills eventually showing through the fog, as turbulent diurnal winds began to complete its dispersal.

In the memoir entitled "The Indian Southwest Monsoon and the Structure of Depressions associated with It" by K. R. Ramanathan and K. P. Ramakrishnan (*Mem. India Met. Dept.*, vol. 26, part 2) an attempt is made to gain a clearer insight into the nature of the depressions accompanying the cyclonic rains that occur in the Indian rainy season, making use on one hand of the more complete information about upper winds furnished in recent years by pilot balloon ascents, not only in India but also in Arabia and Burma, and on the other hand the method of analysis by fronts developed by the Norwegians. The wind data have been used to obtain normal lines of air-flow over this area at heights of 1, 2, 3, 4, 6 and 8 kilometres in the months of May, June and July, the latter month being the one during which the monsoon is normally at its height, and these have been supplemented by mean isotherms at 2, 3 and 4 kilometres calculated from the figures obtained with sounding balloons.

Information of this kind has, of course, great value apart from its application to particular theories of the nature of depressions, while attempts at relating rainfall to the normal conditions of the upper atmosphere, such as the one made in the second part of this paper, are very desirable and

may lead to increased accuracy of weather forecasting. Two depressions during the monsoon of 1930 are examined in considerable detail. The conclusion is reached that the main fronts were formed between 'fresh' monsoon air, resulting from an accelerated advance of this damp air from the far side of the equator, and 'old' monsoon air, that is, air that had a similar origin but had been modified since its first advance, having become the warmer of the two; that fronts also formed between monsoon air and heated continental air that was part of the westerlies of middle latitudes and was the warmer up to about 3 kilometres. It is concluded that depressions retain their strength so long as plenty of fresh and old monsoon air is available.

Another paper dealing with the same subject on the same lines forms the next in this series of memoirs. It is by N. K. Sur, and is entitled "On the Physical Characteristics of Fronts during the Indian Southwest Monsoon" (*Mem. India Met. Dept.*, vol. 26, part 3). Both these papers appear to have been inspired by an earlier paper by Wagner "On the Aerology of the Indian Monsoon" (*Gerlands Bei. Geophys.*, 30, 196–236, 1931). The Indian authors appear to question the truth of Wagner's picture of cold dry westerlies extending right across the north of India, so as to form the cold sector of a vast stationary depression in which the ascending warm current is drawn primarily from the seas to the south and west of India, and has been deflected westwards by the mountains of Burma and Assam.

In Sur's paper stress is laid on the difficulty of determining the lines of flow in the upper air during times of increased activity of the southwest monsoon, owing to the fact that the amount of cloud generally makes it impossible to follow pilot balloons to high levels. It is shown that at times, in the most active stages of the monsoon, a wedge of dry continental air separates the southwesterly winds from the Arabian Sea from the easterlies of the Gangetic valleys, and the characteristics of some of the fronts occurring with these three air streams are discussed with the aid of sounding-balloon data; cases of cyclonic rains in Central India are described in which continental air played, apparently, no part, the easterlies ascending directly over deflected south-westerlies from the Arabian Sea, moving towards the east. It is these studies that make the author doubt the reality of Wagner's conception.

News and Views

Science and Human Values

In the course of a recent address to the Ripon Diocesan Conference at Harrogate, the Archbishop of York, Dr. Temple, remarked that "there has sprung up an immense multitude of new schools which are predominantly scientific in type", and that "while education until lately had been unduly literary in its emphasis, there is a risk now of its becoming unduly scientific". Leaving out of consideration for a moment the inferences drawn by Dr. Temple from these suggested developments, it would be interesting to know what group of schools he particularly had in mind. The largest group in which science occupies a place in the curriculum is the 1765 secondary schools recognised by the Board of Education as efficient. There are more than half a million pupils in these schools, and the attention given to the various subjects of instruction may be estimated from the subjects taken by candidates in School Certificate examinations. Of the 68,406 candidates who presented themselves in the First School examination last year, more than ninety per cent took English, history, French and mathematics. Latin, chemistry and art each attracted about forty per cent. In the Second School examination, the highest percentage of entrants was in mathematics (44·6), and succeeding percentages were French (38·3), English (37·5), history (33·1), physics (31·6), chemistry (31·0), Latin (21·5). This examination leads up to university scholarship standards, and the number of open scholarships and exhibitions awarded by the universities of Oxford and Cambridge last year were in classics, 148; history, 115; science, 104; mathematics, 70; modern languages, 53; and others, 99.

These figures may be taken to represent fairly what are the chief subjects taught in our secondary schools; and they give little support to the view that an immense number of schools is giving predominant attention to science. There is indeed not even a remote possibility that our secondary schools will become unduly scientific instead of unduly literary; and very few men of science would wish them to be. What Dr. Temple fears is that, as science is concerned with observation and measurement instead of human values, "there is great danger in it if the proportion between scientific and humanistic training is seriously distorted". Why, because "All the things that matter most in life, such as friendship, fellowship, and loyalty, are not capable of measurement, nor can they be submitted to any laboratory test", it should be assumed that students of science are necessarily unfamiliar with these intangible attributes is difficult to understand. The purpose of a scientific training should be to observe or investigate evidence before arriving at judgments; and the world would be all the better if this method were followed in political and other social spheres.

The Loch Ness 'Monster'

AT a general meeting of the Linnean Society of London, held on November 8, the Loch Ness 'monster' was for the first time discussed by a scientific society. Sir Edward Mountain gave an account of his endeavours to settle the creature's identity by employing twenty watchers distributed around the Loch under the supervision of Capt. Fraser. These watchers were supplied with cameras on loan from the Kodak Co. Ltd., and also with field glasses. During the first two weeks of last July, the creature was seen by the watchers twenty-one times. In September a film was taken by Capt. Fraser with a telephoto lens at a distance of about a mile from the creature; it was stated that the portion of the creature visible in the film had been estimated by the Kodak Co. to be about eight feet in length. The film was run through the projector several times and a discussion followed. The first impression of most members of the audience was probably that the movements of the creature shown on the film suggested those of a seal, but some of the speakers pointed out difficulties in the way. Commander R. T. Gould did not believe that the creature was a seal; he felt sure that the watchers would have readily recognised it as such. Further, he considered that it could not be a killer whale. Sir Sidney Harmer thought that until further evidence had been produced the verdict should be 'not proven'. He thought that the creature was not a cetacean, but would probably prove to be a seal. Mr. M. A. C. Hinton and Mr. F. C. Fraser felt certain that the creature was a seal, with which opinion Dr. Stanley Kemp disagreed; nor did he believe it to be a cetacean. Sir Arthur Smith Woodward, referring to the popular belief, said that it was hopeless to compare the creature with a Mesozoic reptile as no traces of these reptiles had been found in Tertiary rocks in any part of the world. Capt. J. G. Dollman was firmly convinced that the creature was an otter. The president (Dr. W. T. Calman) and Mr. A. J. Wilmott expressed doubts as to the size of the creature as estimated by the Kodak Company. Enlargements of some of the 'still' photographs taken by the watchers were also exhibited at the meeting.

Electrical Disturbance of Radio Reception

IT is well known that broadcast reception is often seriously interfered with by outside electrical disturbances over which the receiver has no control. A special committee was appointed by the Institution of Electrical Engineers a year ago to consider this problem, and evidence and assistance has been given to it by several official and unofficial organisations. At this early stage, it is clear that radio interference is widespread and constitutes a serious annoyance to the public. The committee finds that listeners and those who advise them have not yet done all that is possible on their receiving sets to mitigate some of the effects of interference. A memorandum has been prepared for the committee by the B.B.C. on the features of design and installation of radio sets which, when attended to, help to lessen, sometimes very appreciably, this trouble. The attention of those who supply radio sets is directed to this memorandum. On the Continent, where State regulations are favoured, little assistance is given to those listeners who do not take reasonable precautions against interference. Still, when the listener has done all he can, there is left a large amount of interference which can only be effectively corrected by suppression at the source. Interfering apparatus generally has a commutator motor, but mercury arc rectifiers and high-tension lines under certain conditions may cause trouble. As a first step towards assisting those manufacturers who desire to produce interference-free appliances, the committee has taken the initiative in the preparation of a specification with this end in view, and it is hoped with the co-operation of the British Standards Institution to issue a complete specification early next year.

THE committee is reluctant to be dogmatic on the subject of compulsory versus voluntary suppression of radio interference. It is not the tradition in England to make regulations until it is certain, first, that they are needed, and secondly, that they can be carried out effectively when made. There is at present much goodwill amongst all concerned, and readiness to help to rectify trouble when it is serious, but the committee believes that a threat, at the present time, to impose compulsory regulations might have the effect of retarding instead of forwarding progress. But when co-operation and goodwill have done their best, there may be a residuum of recalcitrant cases in which some form of compulsion will probably be desirable. Manufacturers are unwilling at the moment to express themselves definitely on the subject of compulsion. The extent of increase of price of appliances depends largely on the level of interference which is permissible. At a special international conference held in Paris last June, an approximate permissible level was suggested, but it was more tolerant than most countries would like to prescribe. It is agreed that, if hard and fast regulations are to be laid down immediately, a tolerant figure is inevitable.

Beilby Memorial Awards

THE administrators of the Beilby Memorial Fund, consisting of the officers of the Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals, have awarded one hundred guineas each to Dr. W. Hume-Rothery, Royal Society Warren research fellow, and to Dr. E. A. Rudge. Dr. Hume-Rothery, who is thirty-five years of age, took first class honours in chemistry at Oxford, and then worked at metallography for three years at the Royal School of Mines under the direction of Sir Harold Carpenter, after which he returned to Oxford for independent research work. His published work includes a book on the electrical properties and theories of metals and alloys, papers on valency relations in alloy structures, and determinations of equilibrium diagrams of metallic systems. Dr. Hume-Rothery has introduced new conceptions and generalisations into the study of alloys, and has

provided much new information as to the general laws and relations which determine the nature and properties of alloys. Dr. E. A. Rudge, who is forty years of age, graduated B.Sc. (London) with first class honours in chemistry in 1915, and thereafter was engaged as an analytical chemist first at Messrs. Johnson and Sons, at their smelting works, and then as an analytical and research chemist in the Osram Robertson Lamp Works. Since 1930, Dr. Rudge has made a special study of the uses and behaviour of timbers in South Wales industries, and of the causes and circumstances of decay in industrial timbers, and he has now in the press "The Decay of Wood in Relation to Humification", and "Wood Decay and Coal Formation".

Palæolithic Pottery

NOTWITHSTANDING the number of claims for the discovery of pottery of palæolithic age made hitherto, none has been substantiated. Such claims, owing to defects in the evidence, have usually had to be rejected or at best to be held 'not proven'. It would indeed be remarkable, if palæolithic man really had been a potter, that among the very numerous relics of his cultural activities which have survived, there should be no trace of his pottery. There are, however, certain fragments recently discovered in East Anglia and the Lower Thames Valley, for which the evidence for a palæolithic origin is unusually well attested. The fragments in question were discovered in stratified deposits at Ipswich and at Swanscombe, and they were associated in both localities with flint implements which are regarded by Mr. J. Reid Moir and Mr. J. P. T. Burchell as of Upper Palæolithic type. A description of six of the fragments of pottery and of the conditions of their discovery are given by Messrs. Moir and Burchell in *Man* of November. The floor from which they were obtained lies at a depth of about twelve feet beneath three distinct strata in Ingress Vale; but deposits of about ten feet depth had been removed before the site was first visited, so that the possibility of intrusion, though unlikely, is not entirely eliminated. One of the fragments obtained is ornamented and certain authorities, it is said, have adjudged it thereby to be of Bronze (Beaker) Age date. Mr. Stuart Piggott, writing in the same issue of *Man*, while hesitating, on account of the size of the sherd, to be more precise in his verdict than "prehistoric", thinks that the Bronze Age beaker is suggested as the immediate parallel among the prehistoric wares of Britain. An influential committee, including among others Prof. P. H. G. Boswell, Mr. M. C. Burkitt, Mr. A. S. Kennard, Dr. L. S. B. Leakey, Dr. K. S. Sandford, and Mr. Reginald Smith, as well as Mr. Reid Moir, is to examine and report on the deposits and their contents.

Respiration of Fruits

IN his Friday evening discourse on November 9 at the Royal Institution, Dr. Franklin Kidd discussed the respiration of fruits. The lecture opened with a number of demonstrations illustrating the way in which oxygen enters fruits and carbon dioxide escapes from them in the process of respiration. Failure of the mechanism for the escape of carbon dioxide is considered as the possible cause of bitter pit, a disease which is responsible for great losses to orchardists. The changes in respiratory activity throughout the life of a typical fruit such as the apple were then described and corresponding changes in chemical constitution of the fruit considered. The conclusion arrived at is that the primary sugar which forms the basis of respiratory oxidations is the active or gamma form of fructose. Attention was then given to the sudden rise in respiratory activity which occurs at maturity and upon which ripening depends. This change, called the climacteric, probably occurs when the acidity of the fruit falls to a certain point, and can be delayed by keeping the fruit in the presence of carbon dioxide. Oxygen is also necessary for the change. After the climacteric, the fruits begin to produce odours, and if these are not allowed to escape freely, fruits become injured. The injuries due to this cause are responsible for the large amount of wastage in fruit storage. The recent discovery that ripening fruits produce a toxic substance which is probably ethylene was discussed. Unripe fruits exposed to the vapour of ripe fruits are stimulated to begin ripening at once. The intermediate stages in the oxidation of sugars in respiration were discussed. In the absence of oxygen the climacteric change which initiates ripening does not occur. The storage life of fruits can be lengthened by treatments which reduce their respiratory activity, such, for example, as certain manurial treatments in the orchard and the storage of fruit in atmospheres rich in carbon dioxide and poor in oxygen.

A Famous Dutch Pumping Engine

IN a paper read to the Newcomen Society on October 17 by Eng.-Lieut. J. J. Bootsgezel, late of the Dutch Navy, an account was given of the pumping engines erected about ninety years ago for draining the Haarlemmermeer, or "The Meer", a tract of flooded land stretching from Haarlem and Amsterdam to Leyden. The task of draining this area was entrusted to the two Dutch engineers A. Lipkens (1782–1847) and G. Simons (1802–68). Three large pumping stations were erected and in them were installed Cornish pumping engines made in Cornwall. The three stations were named after three individuals associated with the draining of the Meer: J. A. Leeghwater, F. G. van Lijnden and N. Cruquius. The engines were put into commission in 1848, and on July 1, 1852, the *State Gazette* announced: "The Meer is dry." The area drained was more than 44,000 acres. Two of the engines have been dismantled, but through the action of the Koninklijk Instituat van Ingenieurs, the Cruquius engine, which last worked on June 10, 1933, has been put in a state of preservation, and the boiler house will be maintained as a museum. Lieut. Bootsgezel was able to give many interesting particulars of the engines. The main features of the Cruquius engine included a single vertical high-pressure cylinder of 7 ft. diameter within a low-pressure cylinder of 12 ft. diameter.

The stroke was 10 ft. There were five piston rods in all, carrying an overhead weight of more than 80 tons and connected to eight great beams disposed radially about the cylinder. From the outer ends of the beams hung the pump rods and pump buckets. Each pump barrel was 6 ft. in diameter and had a stroke of 10 ft. The engine is installed in a fine round castellated building surrounded by a platform with a parapet, and the whole undoubtedly forms the most imposing historical example of pumping machinery in the world, and one which we are sure will attract the attention of many visitors to Holland.

German Sterilisation Laws

RECENT German legislation on eugenic sterilisation is described by Dr. Aubrey Lewis in the *Eugenics Review* (Oct. 1934, p. 183), especially as regards the ordinances issued by the Ministers for Home Affairs and for Justice, and the semi-official commentary of Rüdin, Gütt and Ruttke. Voluntary sterilisation is precluded except for the diseases for which sterilisation is compulsory, and carriers of a hereditary disease may not be sterilised voluntarily. If an appeal is lodged against a sterilisation order, the patient must be detained until his case is disposed of. The physician must report every relevant case encountered in his professional work, but all information collected by the Psychiatric Research Institute is strictly confidential. Overcrowding of the mental hospitals is resulting from the administrative delays. The total population of mental institutions in Germany is reckoned at 160,000, of which 36,000 will probably undergo sterilisation. However, Roemer, an influential psychiatrist, estimates that 400,000 people in Germany are envisaged for sterilisation, 360,000 of which are psychiatric cases. In the same journal (p. 211) Dr. F. Tietze gives an account of the Austrian sterilisation trial at Graz, in which the supreme court reversed the decision of the provincial court and condemned the defendants to imprisonment for practising or advocating eugenic sterilisation, on the ground that the consent of the individual did not exclude 'hostile intention' or change the character of a sterilising operation.

U.S. Petroleum Industry

THE review of the petroleum industry in the United States by Hale B. Soyster and members of the U.S. Geological Survey, Bureau of Mines and Petroleum Administrative Board, recently published by the U.S. Department of the Interior (Circular 11), gives an authoritative, unbiased survey of the American petroleum industry to-day, besides supplying up-to-date statistics of production, stocks, imports and exports. A vital fact is that petroleum reserves, both proved and unproved, are limited and irreplaceable. Wastage, whether physical or economic, is to be deplored and must be combatted with carefully planned and controlled development of all supplies. Latterly, knowledge of methods of preventing waste of both oil and gas and conserving natural energy necessary for recovery of these substances, has rapidly increased, but there are still varied forms of economic waste, to some of which it is difficult to find a solution. Competitive development and premature extraction of petroleum still characterise a majority of new fields and will continue to do so as long as the theory of 'capture and reduction to possession' holds sway.

WITH petroleum increasingly incident in the industrial life of the nation, particularly as motor fuel, and with the knowledge that reserves are limited, it is natural that extensive researches should be prosecuted to find substitutes in the event of shortage. After consideration of possibilities of high- and low-temperature carbonisation, hydrogenation and complete gasification of coal, the most feasible method for large-scale production of gasoline, should petroleum resources decline rapidly in the future, is that of hydrogenation and liquefaction. During this process, however, more original fuel energy is lost than in making gasoline from petroleum, and the cost of gasoline produced is higher. The reassuring fact that processes are available for producing motor fuel substitutes from coal is no excuse for wasteful exploitation of present oil reserves. Coal should be used wherever possible for ordinary heating and stationary power generation, and petroleum strictly conserved in all phases of its production and refinement to avoid the necessity of producing gasoline from coal by an elaborate and expensive process.

Bulk Supply of Electric Power for Manufacturers

SHEFFIELD CORPORATION has now connected up what is probably the largest individual user of electricity in Great Britain to its supply mains, increasing the supply by more than thirty per cent. Messrs. Thomas Firth and John Brown, Ltd., of Sheffield, have works covering 140 acres, and formerly had two generating stations of their own having a capacity of 20,000 kilowatts. Now they have abandoned these, and obtain energy from the public supply mains. Generally speaking, there are many reasons for taking this course. They will be able, for example, to concentrate on their own particular processes of production, leaving the generation of electricity to experts. The space formerly occupied by the boilers and turbines of the private plants can now be utilised for extensions. The basis of the manufacturing processes carried out by the firm are in the melting house, where there are installed furnaces ranging from a capacity of 2 tons to 40 tons. The largest furnace, when melting at its peak load, requires 5,000 kilovolt amperes. The electric furnaces alone melt 1,000 tons per week. This is much greater than the output of any other electric furnace plant in Great Britain. All the supply problems are now dealt with by the Corporation engineers, who have the Grid behind them as a reserve. The bulk supply is given to the works at 33,000 volts, and the distribution is so operated that the lowest possible simultaneous demand is made. The decision reached by this firm to take the public supply will carry great weight with other companies which are considering the problem of continuing to manufacture their own electric power or not.

The 200-inch Telescope

According to Science Service, of Washington, D.C., it is now definite that the two hundred-inch telescope will be erected on Palomar Mountain, 45 miles north-east of San Diego, California. Astronomers have never felt completely satisfied with the 'seeing' at Mount Wilson. Bad 'seeing' arises from local irregularities in the atmospheric refraction which have the effect of distorting the stellar image, especially when a very large aperture telescope is being used; and since it was supposed that convection currents of air running up the steep sides of Mount Wilson contributed materially to the imperfections in the seeing at that observatory, a search for better seeing has been conducted on many plateaux and flat-topped peaks in southern California. The tests of seeing were made by observing Polaris through a standard telescope and noting the character of the image from night to night. The flat-topped Palomar has excellent seeing qualities; it is further advantageous in that it is remote from any great city. Scattered light from Los Angeles and its environs finds its way into the 100-inch reflector on Mount Wilson, and imposes a limit on the length of exposure which one can give to a photographic plate. It may be added that the 200-inch mirror is to be cast at Corning, N.Y., the scene of a previous 200-inch cast, now kept as a 'spare', while the mirror will be ground and the telescope itself constructed in Pasadena, at the California Institute of Technology. This institution will be responsible for the administration of the telescope when completed.

A Portable Sundial

We have received a small portable sundial of ingenious construction, made of aluminium ("Kosmos-Sonnenuhr". Stuttgart: Franckh'sche Verlagshandlung). The workmanship is neat and attractive, and the instrument should be of value in giving instruction to schoolchildren. Some features call for comment. The sundial can be adapted to work in any latitude by rotating one of its members about an axis, the latitude being read off by a pointer against a scale marked from 0° to 90° by steps of 5°. This device, of course, helps the manufacturer to bring out sundials for various latitudes by mass production, and it may conceivably assist a teacher demonstrating fundamental principles to students; but we cannot imagine any real use for a sundial which is to be carried from one latitude to another. A further comment should be made on the method of adjustment in azimuth. A small magnetic compass is embodied in the instrument, and values of the magnetic variation for a number of places are given in the instructions. But if the instrument is to be set up permanently, one had better look up the equation of time in an almanac and set the instrument by adjusting it to give the right time, known independently. It will then, of course, work correctly; and this method of adjustment is easier to effect as well as being more accurate than the use of a tiny compass, liable to gross error through stray magnetic field.

Leaflets of the Astronomical Society of the Pacific

For some nine years past, the Astronomical Society of the Pacific (Merchants' Exchange Building, San Francisco, California, U.S.A.) has issued—at first irregularly, then bi-monthly, and later, in response to growing demand, once every month—a series of leaflets explaining, in simple but authoritative terms, astronomical matters of general interest. These leaflets have become widely known and appreciated, not only by the general astronomically-minded public for whom they were primarily designed and whose interests have been given first consideration throughout, but also by working astronomers as a convenient and trustworthy source of information on certain facts to which reference is frequently required. For example, in Leaflet 30, Dr. F. C. Leonard, of the University of California, gives an account of the newly-discovered planet, Pluto, with the most accurate data available at the time and a useful diagram showing the relation of the orbit to the orbits of the other planets of the solar system; while the distance-velocity relation characterising the extra-galactic nebulæ is explained with a table, diagram and photograph in Leaflet 37 by Mr. Humason himself. The first fifty of these leaflets, each bearing the date of writing, have now been bound together and re-issued as a small volume, and it is satisfactory to note that, since the monthly publication of the leaflets is to be continued, further volumes may be expected in due time. The collection, which it is impossible to praise too highly, unfortunately bears no indication of its cost, but we feel confident in saying that no one interested in astronomy, whatever his degree of knowledge of the subject, will regret the purchase of a copy.

White and Coloured Headlight Beams in Fog

Experiments, made at the National Physical Laboratory, comparing the revealing power of white and coloured headlight beams in fog, are described by Dr. W. S. Stiles in the *Illuminating Engineer* of October. Two headlights of known candle-power distribution were mounted at the height and spacing employed on the average car. They were arranged to throw their beams parallel to and in the direction of the road. The observer stood behind the offside headlight and viewed a disc painted grey with its centre lying on the axis of the light. Test discs of different reflecting powers were used in the experiments. The discs were moved up and down the road, and the distances at which the discs first became invisible were measured. The experiments were repeated with both coloured and neutral light filters held in a frame at a suitable height. Taken as a whole, the results point definitely to the conclusion that the sole effect of the colour filters is due to the reduction in light intensity. This was proved by showing that the range of observations for neutral and colour filters, when plotted against filter transmission, lay on the same curve. The effects that occurred always showed a reduction in the range when compared with the unmodified beam. So far as the experiments went, the revealing power of a

coloured beam is the same as that of a white beam of the same intensity. This conclusion was quite definite for the winter fogs in Surrey, near the National Physical Laboratory. There is a possibility that the conclusions may not hold good for other kinds of fog.

Earth-Sounds in the East Indies

CAPT. P. JANSEN, St. Helens Court, London, E.C.3, has sent us an interesting account of sounds heard by him near the mouths of rivers in the Dutch East Indies. Except in their higher pitch, they seem to resemble the barisal guns of the Ganges delta and the brontides of certain districts in Italy. On the roads of Sourabaya in Java, he says, two or three noises, as of foghorns of different notes, were heard at irregular intervals of a few seconds, each lasting for one or two seconds. In the hold of an empty ship, the noise was deafening. After continuing for one or two hours, the noises ceased as suddenly as they began. Capt. Jansen has heard the same noises, but less frequently, at the mouth of the Palembang River in Sumatra. At the mouths of some of the rivers of the Malay Peninsula, other noises were heard, like that of plucking the strings of a musical instrument, all on the same note and at irregular intervals. Although barisal guns and brontides have for a long time been carefully studied, their origin is still obscure. They are heard frequently in seismic districts and also in countries free from earthquakes. Possibly they have more than one origin, but their frequent occurrence near the mouths of great rivers seems to connect them with the settling of the delta or of the underlying crust.

International Scientific Management

IT is now ten years since the first international conference was held in Prague at which papers dealing with various aspects of scientific management were read. That the intervening period has not been barren of results is the opinion of numerous European and American engineers and men of science who have contributed to the volume, "After Ten Years" ("Po desíti letech"), which has just been issued by the Masaryk Academy of Work under the editorship of Dr. S. Spaček, the Czechoslovak engineer who presided at the inaugural meeting in 1924. The next conference is to be held in London during July 1935, and will be under the auspices of the Federation of British Industries. In view of the many remarkable changes in outlook concerning industrial management, this conference should prove of considerable interest. One authority refers to the fact that scientific management was originally concerned exclusively with output by employees, whereas to-day attention is being focused upon wasteful administrative methods. It is considered that there is scope for much improvement in this direction.

Princeton Institute for Advanced Study

AN interesting account of the origin of this institute is given in *Scripta Mathematica* (**1**, No. 2) and reproduced in the Indian journal, the *Mathematics Student* (**2**, No. 2). Mr. Bamburger and Mrs. Felix Fuld were much impressed by Dr. Flexner's well-known book, "Universities: American, English, German", and they asked the author what centre of learning he would organise if adequate funds were placed at his disposal. Dr. Flexner, after consultation with scholars throughout the world, replied that he regarded mathematics as the most fundamental of all disciplines, and suggested setting up a School of Mathematics. Mr. Bamburger and Mrs. Fuld accepted Dr. Flexner's ideas and gave five million dollars to have them put into effect. Prof. Einstein is director of the institute, which includes also Profs. Veblen and Weyl. Scholarships and fellowships are available for suitably qualified students. These are under the supervision of the professors, but there are no hard-and-fast rules, and each professor is at liberty to adopt whatever methods, formal or informal, he considers best calculated to promote research. This is an important point, since many consider that research institutes have a fatal tendency to become over-organised, to the detriment of original thought.

Positions in the Tristan d'Acunha Group

IT has recently been discovered that certain positions in the Tristan d'Acunha group are incorrectly quoted in vol. 1, Part 1 of the "Report of Scientific Results of the Exploring Voyage of H.M.S. *Challenger* 1873–76". The principal effect of these errors is to place Inaccessible and Nightingale Island in incorrect positions relative to Tristan Island. A full account of the origin of these errors, with a description of the sequence of events which led to their discovery, has been published in the *Empire Surveyors Review* (vol. 2, No. 13, July 1934).

Exhibition of Kinematography

THE Royal Photographic Society, at its house at 35 Russell Square, is holding an exhibition of kinematography until November 30. The exhibition will be open from 10 a.m. to 6 p.m. daily, and a number of public lectures has been arranged. Admission is free. Particulars may be obtained from the Secretary of the Society. The opening lecture was given on November 6 by Mr. F. F. Renwick who described the Dufay colour process. As already mentioned in NATURE (**133**, 678; 1934), this process was to be made available to users of 16 mm. kine film during the summer of this year. When the film was issued it was found to be extremely successful. In his lecture, Mr. Renwick stated that a very large amount of research work had been carried out relating to the application of the process to the full-size kine film. In making copies, much progress had been made, and he was able to exhibit samples made both by projection and contact printing. This accomplishment has already been followed by prominent film-producing companies, and soon Dufay colour films will, no doubt, be included in screen programmes.

A Photographic Centenary

THE year 1834 is famous for the production of the earliest recorded photograph on paper. This was the work of Henry Fox Talbot, who used paper

sensitised by means of silver chloride. Fox Talbot's extensive investigations may be said to have laid the foundations of modern photography. The inventor and his work are briefly described in the *Photographic Journal* (August 1934, pp. 427–435). An exhibition celebrating this centenary of photography is now to be seen at the Gallery of Messrs. Elliott and Fry, Ltd., 63 Baker Street, London. The collection includes a copy of Talbot's book, "The Pencil of Nature", written in 1843, the first book to be illustrated with photographs. Several original prints, including one of Trafalgar Square without the Nelson Monument, and one original paper negative are shown. Talbot was a very close friend of Sir William Herschel, and the early progress of photographic inventions owed much to the suggestions of the latter—notably one made on January 30, 1839, that 'hypo' should be used to fix the photographic records.

Biochemical Society, Calcutta

WITH the object of the promotion of biochemical studies and research, a Biochemical Society has recently been formed at Calcutta. The Society was formally inaugurated on July 6, 1934, at the All-India Institute of Hygiene. The first committee of the Society is constituted as follows: Prof. N. M. Basu, Lieut.-Col. T. C. Boyd, Prof. S. Ghosh, Prof. J. N. Mukherjee, Dr. B. B. Sen, Prof. H. K. Sen, Prof. H. E. C. Wilson, with Dr. B. C. Guha as honorary secretary and Dr. B. Ahmad as honorary treasurer. It has been arranged to hold monthly meetings for biochemical discussions and reading of original papers, reviews, etc. Four meetings have already been held.

Vitamin B_1 Potency of Marmite

THE Marmite Food Extract Co., Ltd., writes, with reference to Mr. A. R. Keast's comments on the vitamin B_1 potency of its yeast extract (NATURE, Nov. 3, p. 696), that the first estimation which showed a content of 840 international units per oz. has been confirmed in a later test on a mixture of eight different samples. The tests were carried out on pigeons by the method described by Coward, Burn, Ling and Morgan (*Biochem. J.*, 27, p. 1719; 1933). Their letter has been referred to Mr. Keast, who points out that Marmite deteriorates with age, and that the pigeon cure method does not always give the same result as the rat growth method of assaying vitamin B_1 in terms of the international standard. Coward *et al.* (*loc. cit.*) found, for samples of dried yeast, that the pigeon method (cure of head retraction in birds given a diet of polished rice) gave a higher value for the vitamin B_1 potency than the rat method (growth of rats on a diet deficient solely in vitamin B_1): the same results were, however, obtained by both methods in the case of a soft yeast extract. They also point out that although the probable error of the pigeon test is much greater than that of the rat test, yet the former has the great advantage of being specific for the factor it is used to estimate.

Announcements

AT the annual dinner of the Institute of Fuel held on November 12, H.R.H. the Duke of Kent presented the Melchett Medal to Dr. Friedrich Bergius, the distinguished German chemist and pioneer in the manufacture of oil from coal. In Germany, Dr. Bergius's hydrogenation process has for several years been used for the production of petrol from brown coal. Methods based on Dr. Bergius's discovery are now being developed in the United States and in Great Britain. At present, Dr. Bergius is working on the production of sugar from wood.

SIR JOHN CADMAN has been elected president of the Institution of Petroleum Technologists for the session 1935–36, and will take office immediately after the annual general meeting on March 12, 1935.

THE following officers were elected at the anniversary meeting of the Mineralogical Society on November 1: *President*, Sir Thomas Holland; *Vice-Presidents*, Mr. Arthur Russell, Sir William Bragg; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith; *Foreign Secretary*, Prof. A. Hutchinson; *Editor of the Journal*, Dr. L. J. Spencer.

PROF. J. B. S. HALDANE, professor of genetics in the University of London, will deliver the tenth annual Norman Lockyer Lecture of the British Science Guild on November 28 at 4.30 p.m. in the Goldsmiths' Hall, London, E.C.2 (by permission of the Goldsmiths' Company), taking as his subject "Human Biology and Its Applications". Tickets, for which there is no charge, are obtainable on application to the Secretary, the British Science Guild, 6, John Street, Adelphi, London, W.C.2.

THE eighth edition of their catalogue of collecting apparatus has been issued by Messrs. Flatters and Garnett, Ltd., 309 Oxford Road, Manchester. The list, which contains a number of new items, includes collecting apparatus for botany, entomology, pond life and geology, besides miscellaneous aquaria, glass top boxes, cabinets and collectors' books.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: An assistant lecturer and demonstrator in chemistry at University College, Leicester—The Registrar (Nov. 23). An assistant lecturer in mining at the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (Nov. 26). An assistant inspector of scientific supplies—The Director-General, India Store Department, Belvedere Road, S.E.1 (Nov. 26). A Pender professor of electrical engineering in the University of London (University College)—The Academic Registrar, University of London, S.W.7 (Jan. 18). A chemical engineer for research in waxes—The Secretary, Industrial Research Council, Department of Industry and Commerce, Lord Edward Street, Dublin.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Velocity of Light

F. K. EDMONDSON[1] has recently stated that the observed values of the velocity of light are well represented by the equation

$$c = 299{,}885 + 115 \sin (2\pi/40)\,(t - 1901),$$

and de Bray[2] has given a plot of this equation, together with certain experimental points. By comparing these points with the complete table of values published earlier by de Bray[3], I find that they include *each* one of the seven final declared values of c, from 1875 to the present time, as well as the preliminary value of Pease and Pearson[4]. The agreement with Edmondson's equation is so remarkable that it seems desirable to tabulate the actual figures. The first eight items in the accompanying table comprise this information[5].

Date	Investigator	Obs. Velocity km./sec.	Obs.-Calc. km./sec.
1874.8	Cornu-Helmert	299,990 ± 200	+ 10
1879.5	Michelson	299,910 ± 50	− 2
1882.7	Newcomb	299,860 ± 30	+ 5
1882.8	Michelson	299,853 ± 60	± 0
1902.4	Perrotin	299,901 ± 84	− 9
1926.5	Michelson	299,796 ± 4	− 1·6
1928.0	Mittelstaedt	299,778 ± 10	− 4·5
1932.5	Pease and Pearson	299,774	+ 0·8
1923.0	Mercier	299,782 ± 30	− 67
1906.0	Rosa and Dorsey	299,781 ± 10	− 185

In addition to Edmondson's 40-year period, Pease and Pearson[4] have found evidences of two shorter periods, one of 14¾ days, and the other of one year. Each had an amplitude of about 20 km./sec., although the shorter period fluctuation nearly vanished during December 1932 and January 1933, reappearing again in February 1933. The origin of these short period fluctuations is still obscure, but if we admit their reality, it is not improbable that a large fluctuation of the type postulated by Edmondson *may* also exist. On the other hand, it is important to notice that these apparent variations occurred only in the direct measurements of c, for which the apparatus extended over one to twenty-five miles. When we turn to the indirect methods, for which a very compact apparatus is used, there is no evidence of a variation.

One of these indirect methods is the measurement of the velocity of electric waves guided by wires (standing waves). J. Mercier[6] has carried out the latest and by far the most accurate work by this method. His result is 299,700 ± 30 km./sec., and I quoted this value in my 1929 discussion[7] of the general physical constants. N. E. Dorsey[8] has, however, recently noted that this value is for air, and when reduced to vacuum becomes 299,782, as given in the table. This revised figure agrees surprisingly well with Mittelstaedt's[5] result, which was obtained with a Kerr cell and with a base line of only 41·4 metres, and with Pease and Pearson's final *average* result. It disagrees, however, by 67 km./sec. with Edmondson's predicted value for the epoch 1923.

The second indirect method for determining c is by means of the ratio of the electrostatic to the electromagnetic unit of electricity. The best experimental value of this ratio, by E. B. Rosa and N. E. Dorsey[9], was obtained at the mean epoch 1906·0. Their direct result is 299,710 ± 10, but this is in terms of international electric units. Using $p = 1{\cdot}00051$ (one int. ohm. $= p$ abs. ohm), I obtained[7] 299,790 ± 10 km./sec. The best value of p is, however, now[10] 1·00046, giving 299,781 ± 10 km./sec. This last value, which appears in the table, is in complete agreement with the results obtained with other relatively compact apparatus (Mercier and Mittelstaedt). On the other hand, it disagrees violently with Edmondson's calculated value for 1906.

To this last conclusion the objection may properly be raised that it is the value of p that should vary with time, rather than the experimental result in terms of international units, and that the 299,781 value properly applies to 1932, the epoch at which $p = 1{\cdot}00046$ was observed, and for which the calculated value of c is 299,773. But the experimental values of p do not show the predicted variation with time. Thus F. E. Smith[11], in 1914, obtained 1·00052, and E. Grüneiser and E. Giebe[12], in 1920, obtained 1·00051. In order to satisfy Edmondson's equation, the value of p, from 1914 to 1932, should vary by 0·00144, an amount twenty-four times the observed variation.

It is thus probable that the fluctuations observed in the directly measured value of c are related in some way to the long base-line employed in the apparatus. That such fluctuations are instrumental, rather than real, is indicated also by the evidence listed by O. C. Wilson[13] and by R. J. Kennedy[14], although the general situation outlined by them is not so clean-cut as their letters might indicate. In brief, this situation is as follows.

The apparent observed change in c is in terms of the standard metre and the mean solar day. Now if we assume the wave theory of light, and if we assume further that there is no dispersion in empty space, so that the group (that is, the measured) velocity is identical with the wave velocity, then we can write the fundamental equation $c = \lambda\nu$, where ν is the frequency of the atomic oscillator producing the light of wave-length λ. It has, however, been shown experimentally, as Wilson points out, that the length of the standard metre, in terms of λ, did not change by a measurable amount from 1892 to 1906. Furthermore, the short-period fluctuations observed by Pease and Pearson should have produced as much as one entire fringe shift per day in Kennedy's apparatus, whereas his observed shifts were always less than 10^{-4} fringe per day.

Hence if the value of c, in terms of the standard metre and mean solar day, is actually changing with time, but the value of λ in terms of the standard metre shows no corresponding change, then it necessarily follows that the value of every atomic frequency, in terms of the mean solar day, must be changing. Such a variation is obviously most improbable, but unfortunately it is not possible to make a direct test, since one cannot compare directly an atomic frequency with any macroscopic standard of time. A real variation in the measured group velocity c, if such variation exists, might then be interpreted as due to a real variation in ν, or as due to a failure of the measured c to equal the *wave* velocity $\lambda\nu$. Parenthetically, it may be noted that any such general variation in ν would not affect the value of the *non-dimensional* quantity, index of refraction, contrary to Wilson's statement.

The last four values of c given in the table represent respectively the best result by each of four quite different methods, and agree remarkably well. As a final weighted average of these results, I suggest 299,776 ± 4 km./sec.

RAYMOND T. BIRGE.

University of California.
Oct. 18.

[1] NATURE, **133**, 759, May 19, 1934.
[2] NATURE, **133**, 948, June 23, 1934.
[3] NATURE, **120**, 602, Oct. 22, 1927. This table has been checked and republished by Mittelstaedt (*Phys. Z.*, **30**, 165; 1929).
[4] Annual Report of Director, Mount Wilson Observatory, 1930–31, p. 218; 1931–32, p. 170; 1932–33, p. 164. See also NATURE, **133**, 169, Feb. 3, 1934.
[5] The first three columns of this table differ from the data already published by de Bray[2] and by Mittelstaedt[3] only in the use of 10 in place of 20 km./sec., for the probable error of Mittelstaedt's own work (*Ann. Phys.*, **2**, 285; 1929). He states explicitly on p. 310 of his paper that 20 km./sec. is his *limit* of error.
[6] *J. Phys. Radium*, **5**, 168; 1924. In this case, also, the published ± 30 km./sec. appears to be an estimated limit of error, rather than a probable error.
[7] *Rev. Mod. Physics*, **1**, 1; 1929.
[8] Congrès International d'Electricité (Paris, 1932), **3**, p. 202.
[9] U.S. Bur. Standards, *Bull.*, 3, 433; 1907.
[10] Nat. Research Council, *Bull.*, 93, 92; 1933.
[11] *Phil. Trans.*, **214**, 27; 1914.
[12] *Ann. Phys.*, **63**, 179; 1920.
[13] NATURE, **130**, 25, July 2, 1932.
[14] NATURE, **130**, 277, Aug. 20, 1932.

β-Rays of Radium D

THERE has been much uncertainty as to the energies of the nuclear β-rays of radium D. All the expansion chamber investigations[1,2,3,4] showed, in addition to the known secondary β-rays, numerous rays of ranges around 6 mm. in oxygen at S.T.P. and therefore of energies of about 20 kilovolts. These were interpreted by Feather[3] and one of us[4] (H. O. W. R.) as due to the nuclear electrons.

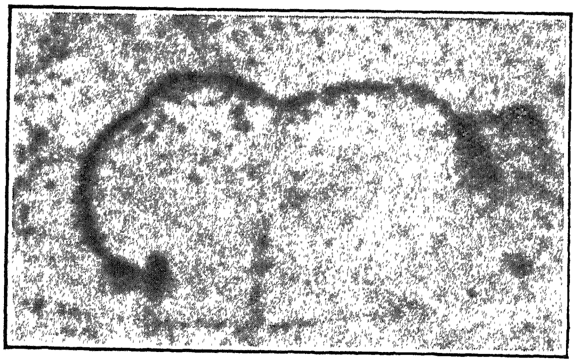


FIG. 1.

On the other hand, (1) Kikuchi[1] had failed to find pairs of secondary + nuclear tracks starting from the same atom on a weakly activated silk fibre; and (2) Stahel[5], using a counter, had failed to count more than 0·83 β-rays per disintegration through a collodion film of small stopping power, though there is evidence that the secondary electrons amount to at least 0·6 per disintegration[4,6,7].

We have obtained new evidence by photographing in the expansion chamber β-tracks coming from radium D tetramethyl. This is a vapour, and the minute quantity used is handled and introduced into the chamber by using lead-tetramethyl as a carrier. It is thus possible to observe the β-disintegration of individual radioactive atoms in the gas.

From measurements of about a hundred disintegrations, we find that the typical disintegration of radium D consists in a 47,200 volt γ-transition accompanied by the emission of a nuclear electron of small range, 0–3 mm. in air. The estimation of the high energy limit of the nuclear spectrum is complicated by the presence of occasional tertiary electrons due to the Auger effect with ranges similar to those of the fastest nuclear electrons. The limit is probably near 10 or 12 kilovolts.

The β-rays between 10 and 30 kilovolts found in previous experiments are absent, so that they must be identified as secondary electrons which had lost energy in the solid material on which the radio element has previously been mounted.

The appearance of a disintegration can be judged from Fig. 1, which is reproduced from a photograph showing three tracks coming from the same atom in air in a field of 650 gauss. They are interpreted as a nuclear ray of about 1 mm. range, a tertiary of 3 mm. and an L secondary of 2·35 cm.

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[1] Kikuchi, *Jap. J. Phys.*, **4**, 143; 1927.
[2] Petrova, *Z. Phys.*, 55, 628; 1929.
[3] Feather, *Proc. Camb. Phil. Soc.*, **25**, 522; 1929.
[4] Richardson, *Roy. Soc. Proc.*, A, **133**, 367; 1931.
[5] Stahel, *Z. Phys.*, 68, 1; 1931.
[6] Gray, NATURE, **130**, 738, Nov. 12, 1932.
[7] v. Droste, *Z. Phys.*, **84**, 17; 1933.

Effects of Cosmic Radiation in a Wilson Chamber at the Hafelekar Observatory (2,300 m.) near Innsbruck

A MAGNETIC field of 1,500 gauss was produced in a Philipp-Dörffel Wilson chamber of 12 cm. diameter and 3 cm. depth, and the effects of cosmic radiation at a height of 2,300 m. above sea-level were investigated. We obtained the following results:

On 1,200 exposures, 160 electron-tracks are visible. Those which are nearly vertical can be interpreted as 31 positive and 34 negative, if we assume that the particles have been moving downwards. The charge of the others cannot be determined, since nothing is known about the direction of their motion. On 25 exposures several simultaneous tracks are visible. A distinct shower with about seven tracks (they are not all equally distinct) was photographed. The radius of curvature could be determined for 98 tracks. The statistics show that a considerable number of soft rays is present. Half the tracks have a radius of curvature of less than 3 cm., corresponding to an energy of 500,000 e.v. 34 have a radius of more than 30 cm., corresponding to 10^7 e.v. Taking the statistics for positive and negative rays separately, we get about the same distribution. Using a strip of lead (0·6 cm. thick), laid horizontally across the chamber, only one particle penetrating it was detected. It did not show any noticeable curvature even after passing through the lead.

Beside the tracks of electrons, tracks of heavy particles were also found. We cannot assume that these rays were due to a contamination of polonium or radium (actually only polonium has to be seriously considered), as three of them had a range of 5 cm. or more (exceeding the range of polonium considerably). One ray of 4 cm. range had both ends in the chamber, which is not likely to occur with polonium. Moreover, 9 out of 15 tracks were vertical, while only 14 out of

94 were vertical in the case of a weak polonium activity *ceteris paribus*. Thus the cosmic radiation is to be regarded as the cause of these rays.

Two thicker but very short tracks (0·6 cm. range) were observed, horizontal, but with both ends in the chamber, very similar to N-atoms set in motion by neutrons. They too must be due to cosmic radiation.

As to the nature and process of origination (whether directly or indirectly due to cosmic radiation) nothing can be said so far.

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Rock Salt Absorption of Cosmic Rays

COSMIC ray absorption measurements have until recently been carried out with relatively few light elements and compounds. Rock salt mines being very often used in the determination of the residual ionisation, it seemed especially interesting to measure the absorption of cosmic rays by this mineral.

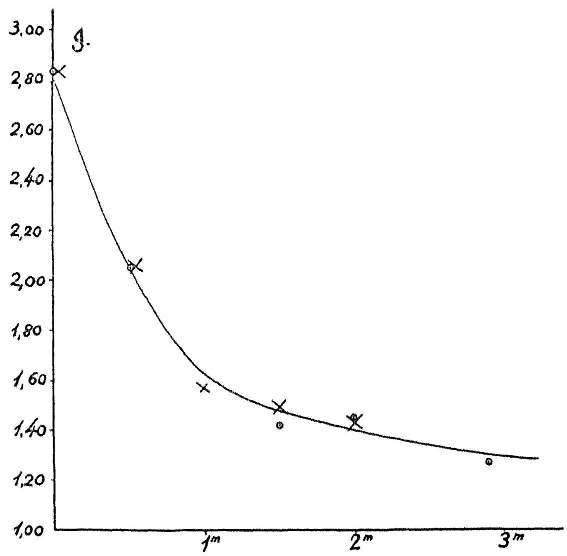

FIG. 1.

Powdered rock salt was used for this research. In one set of experiments, about 40 tons of this material was heaped above the apparatus, which was contained in a wooden box. Care was taken to create conditions analogous to those existing for experiments in water; hence great extension of the external surface was aimed at. In a second set of experiments a kind of salt hill or mound was available to the author. The results of the measurements are shown in Fig. 1, where the observations made within the mound are marked by circles. A Kolhörster apparatus made by Messrs. Günther and Tegetmeyer, of Braunschweig, was used.

On computing the results by means of the $e^{-\mu x}$ function, I find for the coefficient μ/ρ at the depth of 1–3 metres a value of $0{\cdot}7 \times 10^{-4}$ cm.^{2} gm.$^{-1}$, which is many times lower than the corresponding value, namely, $3{\cdot}6 \times 10^{-4}$ cm.^{2} gm.$^{-1}$, for water. Thus, rock salt seems to be the most transparent substance for cosmic rays yet examined. The detailed data concerning this work will be published in the *Acta Physica Polonica*.

I take this occasion to express my thanks to the management of the Solvay Industrial Establishments in Poland, which provided the best conditions for the realisation of this investigation at the rock salt mines of Wapno (Province of Poznań).

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Oct. 11.

Fermi's Element 93

WE have recently pointed out[1] that element 93 should have, according to the Periodic Law, other properties than those displayed by Fermi's element 93[2], and we found, on repeating his experiments with protactinium, that his 13-minute product from uranium is chemically identical with element 91.

The Italian workers, in continuation of their interesting work on neutron bombardment, have just described[3] a new reaction of their element with an atomic number above 92 (co-precipitation with rhenium sulphide), and also found that their product with a period of 90–100 minutes is isotopic with the 13-minute body.

We have studied the rhenium sulphide reaction with protactinium as an indicator, and found that element 91 is precipitated to the extent of 40–60 per cent together with rhenium sulphide from 15 per cent hydrochloric acid solution, exactly like Fermi's products. Our conclusion is therefore that, instead of Fermi's assumption of

$$93 \xrightarrow{\beta} 94 \text{ (or perhaps } 94 \xrightarrow{\beta} 95\text{)},$$

the products with 13- and 90–100-minute periods are isotopes of ekatantalum, changing by β-emission into isotopes of uranium.

Fermi's proof of the non-identity of his products with element 91, based on experiments with brevium, is not conclusive, because we have to expect the freshly formed brevium atoms to be, at least to some extent, in a chemically different state (for example, tervalent ions) than the bulk of the much longer-lived atoms of 'element 93'.

Details of our experiments will be published elsewhere.

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M. S. AGRUSS.

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University of Chicago.
Oct. 12.

[1] A. V. Grosse and M. S. Agruss, *Phys. Rev.*, **46**, 241; 1934.
[2] E. Fermi, NATURE, **133**, 898, May 17, 1934.
[3] E. Fermi, E. Amaldi, O. d'Agostino, F. Rasetti and E. Segré, *Proc. Roy. Soc.*, A., **146**, 495; 1934.

Experiments on Supraconductors

IN a previous letter[1] it was reported that the magnetic induction in tin spheres, which were cooled in an external magnetic field until they became supraconductive, did not vanish entirely, but that part of the magnetic flux remained in the body. This 'freezing in' of lines of force was observed, when supraconductivity was attained either by cooling the specimen in a constant magnetic field or by decreasing the external field at constant temperature. Since then, this result has been confirmed by magnetic experiments by Rjabinin and Shubnikow[2] and by calorimetric measurements by Keesom and Kok[3].

Meanwhile, two of us (T. C. K. and K. M.) have

extended these investigations to different supraconducting substances. For these experiments we used long cylindrical rods in which, on account of the shape (according to Gorter[4]), no magnetic flux should be 'frozen in'. The rods, round the middle part of which a single layer of insulated copper wire was coiled, were cooled below their normal transition point without an external field. Then an external field, parallel to the axis of the rod, was switched on and switched off again. While switching off the field the induction in the coil was measured by the ballistic throw of a galvanometer. At a constant temperature the induction was determined for field strengths varying from zero to far above the threshold value. Such curves showing the induction as a function of the field strength were taken at several temperatures for every specimen. Hence the amount of magnetic flux 'frozen in' could be evaluated by comparing the measurement above and below the transition point.

The results showed that the percentage of 'frozen in' lines of force varied greatly with the material, but that for any individual specimen it was approximately the same at different temperatures. The following data show for different substances the percentage of the flux of induction at the threshold value, which remains in the specimen, when the external field is reduced to zero.

	Per cent		Per cent
Hg	0	Pb + 4 per cent Bi	80–100
Sn (single-crystals)	6–10	Pb + 10 per cent Bi	100
Sn (polycrystalline)	8–12	Sn + 28 per cent Cd (not annealed)	100
Pb	15	Sn + 28 per cent Cd (annealed)	100
Pb + 1 per cent Bi	40–80	Sn + 58 per cent Bi	100

It can be seen that, for pure substances, this percentage is small. In the case of mercury, the purest substance investigated, the 'frozen in' flux was zero within the limits of error. Evidently this fulfils the ideal conditions which correspond to the case treated by Gorter. The experiments on tin, which were all carried out on rods of the same material (tin 'Kahlbaum'), show that there is no considerable difference between single crystals and the polycrystalline metal. But a marked increase in the number of 'frozen in' lines of force occurs as soon as a second component is added. Even comparatively small additions of another substance have the effect of 'freezing in' the entire flux which the rod contains at the threshold value, when the external field is switched off.

Further, it was observed in most cases that the change of induction did not seem to take place at a definite field strength but, at a constant temperature, extended over a field interval, amounting to 10–20 per cent of the threshold value field. For tin we could compare these field values with the threshold values measured in Leyden, and we found that the range in which the induction changed always lay above the threshold value. With respect to the magneto-caloric effect observed by two of us[5] the fact that the induction changes in such a range would mean that the heat of transition too does not appear at a definite field strength but is liberated over a certain range. Whether this phenomenon is common to all supraconductors is of course still an open question.

The magnetic behaviour of alloys mentioned above seems to be in agreement with measurements of the specific heat of a supraconducting alloy ($PbTl_2$) which have recently been carried out by two of us (K. M. and J. R. M.). According to Gorter's[4] thermodynamical treatment of supraconductivity, a large jump in the specific heat at the normal transition point is to be expected for alloys with a steep threshold value curve. No anomaly of the predicted order of magnitude was found.

These results will be discussed in greater detail in a future publication.

T. C. KEELEY.
K. MENDELSSOHN.
J. R. MOORE.

Clarendon Laboratory,
Oxford.
Oct. 26.

[1] K. Mendelssohn and J. D. Babbitt, NATURE, **133**, 459, March 24, 1934.
[2] G. N. Rjabinin and L. W. Shubnikow, NATURE, **134**, 286, August 25, 1934.
[3] W. H. Keesom and J. A. Kok, *Physica*, **1**, 503; 1934.
[4] C. J. Gorter, *Arch. Teyler*, **7**, 378; 1933. NATURE, **132**, 931, Dec. 16, 1933. C. J. Gorter and H. Casimir, *Physica*, **1**, 306; 1934.
[5] K. Mendelssohn and J. R. Moore, NATURE, **133**, 413, March 17, 1934.

A Magnetic Study of the Metallic State and the Fermi-Dirac Statistics

IT was a signal contribution to the chance of an experimental test of the Fermi-Dirac statistics when Bloch[1] included the interaction of the electrons and the lattice in the representation of a metal. This representation is much nearer to actual metals than an abstraction such as a free electron gas. Fortunately, the theory leads to a paramagnetism of the metal electrons, which does not differ radically from the paramagnetism of free electrons, approximating the latter as the binding between the positive ions and electrons becomes weaker.

The distribution of spin and its magnetic susceptibility as derived with the Fermi-Dirac statistics are functions of the molal volume and the temperature in addition to the degree of binding. At a given temperature, an increase in the molal volume will lead the distribution from the degenerate state where practically all the electrons have paired off their spins to a state where the individual spins are independent of each other, the state where classical statistics is valid. The same general course is followed when the temperature is raised at fixed volume.

In actual metals, the differences in molal volume are too slight to make much difference in the distribution of energy or of spin among the electrons, and any change in distribution with temperature would become marked only above the boiling points of the metals.

Our research consisted in diluting a metal with a non-metal, the non-metal having its electrons so tightly bound and magnetically neutralised that in the first approximation the paramagnetism can be ascribed to the electrons of the metal. In this way, a great variation in molal volume can be studied, and the temperature where considerable changes in the distribution of spin occur is brought within range for experiment. Various combinations of metal and non-metal appear to be miscible in each other, such, for example, as the alkali metals in salts and in hydroxides. We have been measuring first the magnetic susceptibilities of metals dissolved in liquid ammonia, although this precise situation was not treated by Bloch. However, it was hoped that the data would parallel the results of the theories of Pauli and of Bloch. As a guide in the selection of substances, we depended upon the well-known fact

that alkali and alkaline earth metals conduct electrolytically in dilute solutions and conduct metallically in concentrated solutions. The concentrated solutions have every appearance of liquid metals. Indeed, a saturated solution of sodium, for example, has a greater electrical conductivity than solid iron[3]. We have here, it seems, the gradation in metallic properties we desire.

A rough computation on the basis of a free electron gas shows that metallic sodium would reach the critical temperature at about 40,000° A.; that is, its electrons would begin to uncouple in marked degree and pass into the state where they act as independent elementary magnets. At 0·1 N (0·1 mol. per litre), the critical temperature is about 600° A. At 0·02 N the corresponding temperature is about 225° A., which happens to be within the temperature range of liquid ammonia. At 0·01 N the temperature is about 140° A. and at 0·001 N about 30° A. Our preliminary measurements at 230° A. show that at about 0·5 N the atomic susceptibility of sodium has the same order of magnitude as pure metallic sodium. At 0·017 N it has about thirty times the atomic susceptibility of the pure metal, and at 0·0022 N it has about a hundred times the susceptibility of pure sodium, now possessing about two thirds the paramagnetic susceptibility which would arise from independent magnets having one half unit of spin.

These measurements will be repeated with greater accuracy. There may possibly emerge some indication of the diamagnetism of free electrons. We are also measuring other metals, as well as the temperature coefficients of their susceptibilities.

SIMON FREED.
HARRY G. THODE.

George Herbert Jones Laboratory,
University of Chicago.
Oct. 10.

[1] F. Bloch, *Z. Phys.*, **53**, 216; 1929.
[2] W. Pauli, Jr., *Z. Phys.*, **41**, 81; 1927.
[3] L. Farkas (*Z. phys. Chem.*, A, **161**, 355; 1932) has made a theoretical study of these conductivities.

Vibration Spectra and Force Constants of 'Heavy' Acetylene

RECENTLY several workers[1,2,3,4] have published short accounts of observations on the infra-red and Raman spectra of the 'heavy' types of acetylene, namely, HCCD and DCCD. These observations are of considerable importance in helping one to arrive at a more complete understanding of the exact nature of the potential function which defines the force field within the acetylene molecule. Although the observations are not yet sufficiently extensive to enable one to solve this problem completely, it seems desirable at this stage to point out what appear to be serious errors in the present interpretations of these observations, and to show that most of the present data can be satisfactorily correlated on the basis of two quite simple assumptions.

The first is that, for displacements along the axis of the C_2H_2 molecule, only two force constants are required to determine the motions of the atoms, namely, k_1 between the C and H atoms, and k_2 between the two C atoms. The second is that k_1 and k_2 remain unchanged when either or each of the H atoms is replaced by a D atom.

The first assumption is well known to be justified, since it implies a relation[5] between the three parallel frequencies of ordinary acetylene of the form

$$\nu_2^2\,(\nu_1^2 - (1 + m/M)\nu_1^2) = (\nu_3^2 - \nu_3^2)\ \nu_3^2\,;$$

and since on substituting $\nu_1 = 1{,}974$ cm.$^{-1}$, $\nu_2 = 3{,}372$ cm.$^{-1}$, and $\nu_3 = 3{,}288$ cm.$^{-1}$ (the well-established values of these frequencies) one finds excellent agreement between the two sides of the identity. The use of a similar assumption in the calculation of the parallel frequencies of diacetylene by Bartholomé[6] provides an independent confirmation.

If we now compute the values of the frequencies ν_1, ν_2, and ν_3 for the isotopic molecules HCCD and DCCD, using the second assumption and taking $k_1 = 5{\cdot}9 \times 10^5$ dynes./cm., $k_2 = 15{\cdot}9 \times 10^5$ dynes./cm. (the values deduced from HCCH) we obtain the values given in Table 1. So far the only *direct* observation reported of a fundamental (parallel) frequency in the isotopic acetylenes is that of ν_1 for DCCD by Glockler and Davis[4]. It is seen that the agreement of the calculated and observed values is as good as could be desired. The value of 1,901 cm.$^{-1}$ calculated by Glockler and Davis for this frequency is obviously wrong since it depends on a single force constant between the two C atoms.

Table 1.

	HCCH	DCCD		HCCD		
	Observed	Calculated	Observed	Calculated	Infra-red (Herzberg *et al.*)	Infra-red (New interpretation)
ν_1	1974	1758	1761	1858	~1900	~1860
ν_2	3372	2679	—	3343	~2650	~3350
ν_3	3288	2413	—	2543	~3300	~2550

As regards the fundamental frequencies of the HCCD molecule, we have only the observations on the overtone bands in the photographic region[2,3] from which to deduce them. Herzberg, Patat and Spinks have interpreted the bands observed by them in the way shown in Table 2, and have consequently deduced that for HCCD $\nu_2 = 2{,}650$ cm.$^{-1}$ and $\nu_3 = 3{,}300$ cm.$^{-1}$. Such an interpretation is very suspect in that it makes ν_3 a higher frequency in HCCD than in HCCH. It is just possible that ν_2 might be higher in the isotopic molecule, but it is difficult to see how ν_3 could ever be so. The new interpretation proposed in Table 2 seems more likely to be the correct one, in that it has been based on the newly calculated fundamentals and gives very reasonable assignments for all of the observed bands. The fact that Dennison's selection rules[7] for the overtone bands of HCCH are not valid for those of HCCD naturally makes a unique interpretation of the present data impossible, but further work in the infra-red on the fundamentals and lower overtones ought very soon to decide between alternative explanations of particular bands.

Table 2.

Observed Band in cm.$^{-1}$	9706	9139	8550	8410
Interpretation of Herzberg and others	$3\nu_3$	$2\nu_3+\nu_2$	$\nu_3+2\nu_2$	$2\nu_3+\nu_1$
New interpretation	$4\nu_3$	$\nu_3+2\nu_2$ or $3\nu_3+\nu_1$	$2\nu_3+2\nu_1$ or $3\nu_3+\nu_4+\nu_5$	$2\nu_3+\nu_2$

Unfortunately, the perpendicular bands observed by Randall and Barker[1] cannot be correlated so

simply, since the potential function for displacements perpendicular to the axis of the C_2H_2 molecule is rather more complicated, and in fact the bands found by Randall and Barker will have to be employed in order to determine it.

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Laboratory of Physical Chemistry,
Cambridge.
Oct. 20.

[1] H. M. Randall and E. F. Barker, *Phys. Rev.*, **45**, 124; 1934.
[2] G. Herzberg, F. Patat, and J. W. T. Spinks, NATURE, **133**, 951, June 23, 1934.
[3] C. A. Bradley and A. McKellar, *Phys. Rev.*, **46**, 236; 1934.
[4] G. Glockler and H. M. Davis, *Phys. Rev.*, **46**, 535; 1934.
[5] R. Mecke, *Z. phys. Chem.*, B, **17**, 1; 1932.
[6] E. Bartholomé, *Z. phys. Chem.*, B, **23**, 152; 1934.
[7] D. M. Dennison, *Rev. Mod. Phys.*, **3**, 280; 1931.

Diffusion of Heavy into Light Water

WE have made measurements of the diffusion coefficient of heavy water (0·5–3·0 mol per cent) in aqueous solutions. The value provisionally obtained is about 9×10^{-4} cm.^{2}/sec. at 15° C. Since this is appreciably greater than is to be expected from the mass diffusion of water molecules (the largest recorded diffusion coefficient, namely, that of H_2 in H_2O, is about 4×10^{-5} cm.^{2}/sec.), it appears that an atomic interchange, such as has been suggested by Bernal and Fowler[1] to account for the abnormal electrolytic mobility of the hydrogen and hydroxyl ions, is involved.

We hope to improve the accuracy of the method, and to determine the temperature coefficient.

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[1] *J. Chem. Phys.*, **1**, 515; 1933.

Dielectric Potentials of Physiologically Active Substances

SOME physiologically active substances change the surface tension very little and are probably adsorbed at tissue interfaces as they exhibit an action. It seems possible to explain their adsorption and action by supposing that they change the electrical potential on the interface of different dielectrics, influencing but little the surface tension, which is taken into consideration by W. Gibbs in his well-known equation.

Measurements made in this laboratory on the potential at the interface active substance solution – air with the aid of a Lindemann electrometer and a special modification of Kenrick's method gave the following preliminary results:

Substance	Solution	Potential
Quinine	*M*/100 quinine sulphate	430 mv.
	M/100 quinine bihydrochloride	300 ,,
Cinchonine	Saturated solution of the base	140 ,,
Cinchonidine	Saturated solution of the base	10 ,,
Morphine	1·49 gm. hydrochloride to one litre of solution	0 ,,

Only a few of the measurements are given here. A full account will be published elsewhere in the near future. The potentials exhibited are very great at low concentrations compared with the known potentials of other substances measured by Kenrick and Frumkin. The potential changes with the hydrogen ion concentration. This may be explained by the influence of the ions on the structure and dissociation of the alkaloids. The dextro- and lævorotatory isomers of the same substance show different potentials.

Some physiologically active substances give no potential on the interface solution – air (*in vivo*, for example, the lung), but they give potentials on the interface water solution – solution of greater dielectric constant. Such dielectric constants are known in the living organism; for example, substance of the brain, nerves and the surrounding solution.

The potentials seem to explain a vast field of physiological action and they deserve a special name. I propose the name 'dielectric potential' in distinction from the potentials met with on the interface conductor – solution, as in the elements of electrochemical cells.

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Cracow.
Oct. 14.

Pit-Head Generation of Electric Power

THE analysis of my address at the Aberdeen meeting of the British Association contributed by a correspondent to NATURE of October 13 emphasises too strongly the part dealing with pit-head stations. My main theme was that the selling price of electricity was approaching a figure below which the demand would greatly increase, and only by this increase could the heavy cost of distribution be materially reduced. In order to start this increase in the demand the use of pit-head stations and the adaptation of industrial steam were advocated, and it was claimed that the existence of the Grid afforded facilities for bringing in these sources of supply, which formerly were difficult to use. A reduction in local rates was put forward as an additional help to this end, not as an argument in favour of pit-head stations.

The condensing water difficulty is always brought up against pit-head stations, and is usually overstated. Nor is your correspondent an exception. He quotes the Battersea station as having a thermal efficiency of above 26 per cent, using river water, against Hams Hall at Birmingham with 23·3 per cent using cooling towers; but he fails to take into account the facts that the Hams Hall machines are 30,000 kw. and work at 350 lb. steam pressure, while the Battersea machines are 67,000 kw. working at 600 lb. These two conditions alone would account for nearly all the difference in efficiency. Moreover, Hams Hall works at the low load factor of 0·32, which lowers its efficiency. My statement that "the gain in efficiency due to the high vacuum is often exaggerated by failure to apply comparable conditions", was not unjustified.

Your correspondent also gives alarmist figures about the enormous loss of cooling water by evaporation. This is now slightly less than the amount of steam condensed, and in a 100,000 kw. station, working at a load factor of 0·4, it amounts, on the average, to a stream of water one foot wide and one foot deep flowing at the slow rate of a little more than one mile an hour. Few mines are so fortunate as to have less water to pump than this.

Increased distance of distribution is another objection, but this is now a very small matter if the distance is moderate. It is much cheaper to transmit electricity than coal. Moreover, the presence of a very large station in an urban area is becoming recognised as undesirable, and the concentration of industry in a few large centres no less so. It is hoped

that the wide distribution of electric power will reduce this tendency, and for such supply the more numerous stations will be advantageous.

The proper price for this low grade coal must be controlled by a joint board of some kind, but it will not be fixed at 5*s*. per ton, any more than the price of steam coal is fixed at its present price. But for the various reasons given in the paper, the fair price will always be a low one.

Your correspondent agrees that there may be individual cases where pit-head production can be economically undertaken. That is exactly my plea. Let the most advantageous places be undertaken first, and then consider the extension of the scheme as opportunity arises. An important asset in the plan is that it can be carried out gradually, and can be developed to any degree of completeness, without detriment to its successful operation at any stage. It may merely supplement the present stations, or it may ultimately replace them, but there is no commitment to a large scheme which once begun must be completed to obtain success. Although the potentialities are very large, the initial risk is small and each step can be proved before a further advance is made.

FRANCIS G. BAILY.

Juniper Green,
Midlothian. Oct. 18.

Inland Water Survey

AFTER reading the valuable leading article in NATURE of October 27 on "Inland Water Survey", with most of which I am in full sympathy, I should like to comment on the view therein expressed that: "Until a survey has been instituted and in a large measure completed, it cannot be known with any degree of certainty and reliability to what extent supplies are actually available for distribution", and that such schemes as the creation of a statutory central water authority, or regional committees are "not ripe for consideration at the present juncture".

It is evident that a survey of the water resources of Great Britain, which many of us hope will be supervised by the Department of Scientific and Industrial Research, will necessarily be a slow and laborious investigation, lasting for an indefinite period. But in the meantime, urgent schemes for the allocation and distribution of water will arise and have to be dealt with in the light of existing knowledge of the water resources in the areas relative to such schemes. It may well be that an *ad hoc* investigation of the resources of the district in question would have to be carried out promptly, possibly with the aid of the central water survey organisation.

As I see the whole problem, the establishment of a central water authority, with its subordinate statutory regional water committees, which in the opinion of our leading water engineers is urgently required at the present time, for many sound reasons which need not be stated here, is not inconsistent with the simultaneous institution of a national water survey. The former would function in the administration, allocation and distribution of water supplies, while the latter would organise the purely scientific and technical survey of our resources. The ideal no doubt would be to have available the results of a completed survey before attempting to allocate resources, but in the meantime we must be content to absorb and utilise the new knowledge as and when it becomes available. I think that if this dual aspect of the question is kept in mind, it might help the Government to arrive more readily at a decision.

W. S. BOULTON.

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Oct. 29.

WE can readily concur with Prof. Boulton in his view that "the establishment of a central water authority . . . is not inconsistent with the simultaneous institution of a national water survey". Both matters are alike important, but while there appears to be no valid obstacle to the immediate inauguration of a survey, we see much of a highly contentious nature in the various proposals put forward for the constitution of a central water authority. Our view is that the survey, which is a primary necessity, should not be held up pending a settlement of these purely administrative details, which cannot in the least affect the operations of a survey. In the practical vernacular of the engineering profession, we are anxious to see the Department of Scientific and Industrial Research given authority to "get on with the job".—Editor, NATURE.

The Theory of Colour-Vision

In 1889 I put forward the theory that light perception and colour perception were quite distinct and were distinguished by different cells in the brain, and that colour-blindness was a defect in the evolution of colour perception. This theory enabled me to predict a large number of new facts, and with my experience as special examiner and adviser to the Board of Trade on colour vision and eyesight for fourteen years, with the very fine apparatus in my laboratory, no fact has been discovered which is not in agreement with the theory.

Henschen has shown that there are different cells in the visual centre for the perception of light and colour. Colour-blindness cannot be explained on the old theories and any classification on them is erroneous. Let us consider two examples of the 50 per cent of dangerous cases which pass the old wool test with ease. One has shortening of the red end of the spectrum; he will look at a blazing red light of long wave-length and declare there is nothing there, but will recognise red of shorter wave-length to the lowest degree of luminosity perceptible to the normal sighted. Then take a trichromic (one who sees only three colours in a bright spectrum, red, green and violet); his chief defect is that he has no yellow sensation and therefore is in difficulty over so-called white lights which are really yellow. A trichromic must not be confused with an anomalous trichromat. 90 per cent of the dangerously colour-blind agree with the normal equation, an anomalous trichromat does not.

There are innumerable varieties of dichromic vision, not two main varieties as stated in many books. The dichromic sees two colours in the spectrum, red and violet, with a white interval. This white interval may be so large as to include yellow, green and blue and the luminosity curve may be normal. Very many dichromics pass the wool test with ease. A man may through disease become totally colour-blind whilst retaining his light perception and normal visual acuity.

F. W. EDRIDGE-GREEN.

Board of Trade,
London, S.W.1. Oct. 27.

Peculiar Behaviour in a Female Rat

It is not uncommon for the female rat to exhibit disapproval of a male rat introduced into her premises and to allow her hostile attitude to include any other female sharing her cage. Her attitude towards the male, at such times, is merely defensive—if he approaches her, she rises on her hind legs and utters cries of distress, repelling him with her forepaws. The circumstances seem to have demanded stronger measures from a female rat recently observed. At the same time as her litter was removed, a male was placed in her cage. Immediately she drove him to a corner in the forefront of the cage, where he was obliged to stand on his hind-legs and to remain so standing, while she excitedly brought pieces of hay and, literally, walled him in. Her actions were accompanied frequently by protesting cries which became vehement if he tried to fall on all-fours. The hay was patted in place, to the full height of the cage, so that she might not see him. She herself was totally without bedding ultimately. The state of siege lasted for some six or seven hours, when a truce was apparently arranged.

It is unlikely that the removal of her litter had anything to do with the attitude that this female exhibited, as her youngsters were thirty-four days old at this time.

The intruder made no protest, manifesting a gallantry which is almost invariable in the male rat.

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Oct. 25.

British Association Mathematical Tables

THE appreciation in NATURE of September 13, p. 414, of the work of the Committee responsible for the British Association Mathematical Tables is very gratifying, but the inevitable inference from the note is that financial help is no longer required, and I shall be glad if I may be allowed to correct this impression: the need is still urgent. It is true that the Committee reported at Aberdeen that the publication of the tables of Bessel Functions is now assured. But the grants mentioned in the Committee's report and in the note in NATURE are precisely those which were mentioned in these columns on March 17, and the appeal made then for further support, far from being successful, has elicited as yet only the most meagre response.

The explanation of the change of tone is in the new proposals for publishing. The Cambridge University Press is prepared to handle the Bessel Function volumes not as a business proposition but as a subsidised undertaking on which some loss is to be expected. Considered in relation to a capital cost of about £1,000 for producing the two volumes, the sum of £150 available was properly described in March as "little more than an earnest of belief in the Committee's plan". Regarded as a contribution to a subsidy, the same sum has a very different value. Despair has, therefore, given place to hope. The Committee's assurance that the volumes will appear is, however, not a statement of account but an expression of confidence. It is just possible to pay the subsidy on the first volume now, and that volume need not be delayed to some indefinitely remote future. The Committee is encouraged to proceed steadily with the preparation of the second volume, but the work cannot be completed until further grants or donations are made: to readers of NATURE a word should be sufficient.

E. H. NEVILLE
Chairman, British Association
Mathematical Tables Committee.

University,
Reading.
Oct. 27.

Oxygen Preparation from Sodium Peroxide: A Dangerous Experiment

A FEW days ago oxygen was prepared in the course of a lecture experiment by allowing water from a drop funnel to fall upon some ordinary sodium peroxide (not specially purified) in a flask. On applying a glowing splint there was an immediate and terrific explosion, which was heard throughout the Department and was regarded by those in the more remote rooms as a student's reminder that November 5 was not far distant. The flask was entirely pulverised and the demonstrator was badly cut with flying glass. Fortunately, no students were injured.

It appears probable that the peroxide contained some unoxidised metallic sodium so that in contact with water an explosive mixture of hydrogen and oxygen was evolved. We have never heard of this happening before although the experiment has been carried out as a routine lecture demonstration scores of times during the last fourteen years. We should be interested to hear if any other lecturers have had a like experience.

J. NEWTON FRIEND.
S. MARKS.

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Birmingham.
Oct. 22.

Mechanism of the Liesegang Phenomenon

IN order to throw light on the mechanism of the Liesegang phenomenon, I decided to investigate this under the simplified conditions obtained by causing ions to migrate into gels under a fixed external potential gradient.

Preliminary results obtained from the migration of Ag^+ ions into gelatine gels containing sodium chloride (approximately $N/100$) showed that, under these conditions, sets of rings were obtained spaced approximately equidistant from one another along the direction of the current, one experiment giving eleven rings so arranged.

These results are of interest from the point of view of the theory advanced by Michaleff, Nihiforoff and Schemjakin[1], and supported by some experiments in which the rings obtained from free diffusion were observed, and again by Christiansen and Wulff[2], that the phenomenon is due to the de Broglie wavelength of the diffusing molecular species, in that on this theory equal spacing of the rings under a potential gradient would be expected; while the actual spacing obtained was of the order of magnitude predicted by this theory.

These experiments will be continued.

E. C. BAUGHAN.

Balliol College,
Oxford. Oct. 20.

[1] *Kolloid Z.*, **66**, 197; 1934.
[2] *Z. phys. Chem.*, **26**, B, 187; 1934.

Research Items

Archæology in North-East Greenland. In the course of a hunting expedition to north-east Greenland in 1929–31, and a further expedition in 1932–33, the remains of ancient Eskimo settlements extending from Cape Borlase Warren to the south of Antarctic Harbour were examined by Dr. Soren Richter, whose report is published under the title "A Contribution to the Archæology of North-East Greenland" (*Skriften om Svalbard og Ishaveg*, No. 63). The Eskimo evidently chose the sites of their permanent habitations, their winter huts, with an eye to the factors of light, hunting and facility for movement afforded by the state of the ground. They were always near the coast, as watching for marine animals was then their most constant occupation. Small game was also hunted; but reindeer hunting apparently took place only in the late summer and autumn. About 270 Eskimo huts, distributed in 58 settlements in the region of the north-east, are now known to the author, and about 150 to the north and south belonging to the abandoned north-east district. Probably most of the settlements were occupied only for a very short time, and the population was small and readily migratory. Two settlements only had more than ten huts. The huts are fundamentally of the same type, characterised by being built into a slope, with the roof practically flush with the terrain. The walls were built of single broad stones or narwhal skulls, placed edgewise, serving mainly to prevent the sides from falling in. Curiously enough, narwhal skulls were preferred, even when stone was available. The culture throughout is remarkable for its versatility, but shows no sign of a very high antiquity, a date of about five hundred years ago being suggested.

Social Grades in Mangaia. While acting as a temporary High Commissioner of the Cook's Islands Administration in Mangaia, in 1929–30, Dr. P. Buck (Te Rangi Hiroa) was enabled through his official relations to collect certain material towards an ethnological survey (Bull. 122, Bernice P. Bishop Museum, Honolulu). The Mangaians have long been in contact with Europeans, and owing to the attitude towards their previous customs encouraged in the early days of contact, information is not now readily to be obtained. Within the tribes, social grades were the high chiefs, lesser chiefs and the commoners. The highest title (*ariki*) is vested in the first-born son of a first-born son, and cannot be held by a female, even though she be the elder, nor can her children displace their cousins, who are born of her younger brother. The *ariki* is senior to all other chiefs in the tribe. The junior members of the chiefly line were termed *rangatira*. If they established strong families they had to be considered in the politics of the tribe and were consulted by the *ariki*. The *ariki* was often a figure-head. The younger members of the families, who in course of time were pushed further and further away from the chiefly line of succession, became the commoners. They were free men, but the higher positions in the tribe were occupied by their seniors in birth. In the course of history, the prestige of the successful warrior (*toa*) began to overshadow that of the *rangatira*. Successful leadership in war determined whether a tribe kept its own land and acquired other lands, for after a battle the victors seized and divided among themselves the taro lands of the vanquished. The war leader of the successful tribe became the temporal lord of Mangaia, holding more power than any hereditary official. Thus the hereditary chief could not rely on his seniority alone, but had to be a warrior as well. In one instance, in which the descendants of the chief displayed no military ability, the leadership passed to a junior branch.

Bilingual Problem in Education. Dr. M. E. Bickersteth read a paper before Section J (Psychology) of the British Association meeting at Aberdeen on the bilingual problem in the Gaelic-speaking districts of Scotland. Psychological tests were given in eighty very isolated schools in the highlands and islands, and the results showed that the children scored higher when tested in Gaelic or by means of performance tests, but were behind English-speaking children of the same age in the development of logical thinking. Dr. Bickersteth thinks the results were influenced by the very isolated lives of the children, and by the fact that in the schools not Gaelic but English became the medium of instruction before the junior school stage was reached, causing emotional confusion and retardation in the development of thinking.

Atlantic Synentognathi. In a very interesting paper, Mr. C. M. Breder, Jr. (New York Aquarium) discusses the habits and development of certain belonids and their relatives (Papers from the Tortugas Laboratory and Carnegie Institution of Washington, 28, 1934). The fishes were studied in the field and in the laboratory in various places including New Jersey, Panama, Florida and Nassau. Marked differences in behaviour, swimming attitudes and habitat are shown in the live fishes, especially those belonging to the Belonidæ, which, when adult, are all surface or near-surface feeders, pursuing and eating great numbers of small fishes and invertebrates. The young, until the beak is developed, are of necessity more delicate feeders, but *Tylosurus raphidoma*, having no half-beak stage, is predaceous at all stages studied. The development of *Tylosurus* is distinctly different from that of *Strongylura* and apparently much closer to the line leading to the *Hemirhamphidæ* than is *Strongylura*, which may be looked upon as a more specialised side branch. All have many enemies. The Belonidæ are preyed upon by the larger fishes, including sharks; the Exocetidæ, although capable of leaping high into the air, are devoured in enormous quantities by birds and also by fishes, and form the bulk of the food of huge colonies of terns and noddies. The paper is well illustrated by line drawings and photographs.

Clearing and Dyeing Fish for Bone Study. Miss Gloria Hollister has been singularly successful in treating the bodies of fishes so that the bony skeleton, deeply dyed, can be plainly examined *in situ* through the soft tissues, rendered transparent by a process of clearing. She gives an account of her technique in *Zoologica*, 12, No. 10. The staining medium is the well-known one of alizarin dye, and advice is given on the precautions needed to ensure satisfactory results. The more important part of the technique, however, is the means by which the flesh is depigmented and rendered transparent. After specimens are removed from the alizarin bath, they are placed

in a weak solution of potassium hydroxide and then submitted to ultra-violet light from an alpine sun-lamp. Miss Hollister finds that this is the only treatment which, without damaging the specimens, will extract the black pigment from deep-sea fishes and render the tissues crystal-clear with every detail of bone visible. Preparations made in this way can be preserved permanently if they are kept in chemically pure white glycerine to which a small crystal of thymol has been added, and glass or rubber stoppers are used instead of cork. The thymol is needed to prevent the formation of mould, while the use of cork is to be discouraged because it discolours the glycerine and causes the tissues of the fish to turn dark brown. The efficacy of Miss Hollister's technique is shown by the fact that she has made successful preparations of approximately three thousand of the shallow-water and deep-sea fishes found off Bermuda.

Parasites of the Codling Moth. In the July issue of the *Bulletin of Entomological Research* (25, Pt. 2, 1934), Mr. H. T. Rosenberg of the Parasite Laboratory of the Imperial Institute of Entomology contributes a study on the above subject. The codling moth (*Cydia pomonella*) is a widespread pest of the apple, and a study of its parasites is a necessary preliminary to the adoption of measures of biological control. In the present instance, extensive collections of the host larvæ were made in various parts of France and the parasites bred out in England. The total percentage of parasitism was found to be very low, not exceeding 25·7 per cent in any region of France from which the material came. Of individual parasites, the ichneumonid *Pristomerus vulnerator* had the highest parasitism (14·3 per cent). There is insufficient evidence to show that the codling moth is appreciably controlled by parasites of the larva in France. Other controlling factors were also studied, and it is concluded that predaceous birds and the removal of the larvæ during the gathering of the crop are of more importance than parasitism of the larva.

Meiotic Chromosomes of *Allium*. A view of chromosome structure and division containing several new features is contained in a paper by Prof. T. K. Koshy (*J. Roy. Micro. Soc.*, 54, p. 104). He has studied the meiotic chromosomes in twelve species of *Allium*, as complementary to a previous investigation (see NATURE, May 26, 1934, p. 800) of the somatic chromosomes. He finds that the telophase split of the chromosomes is not suppressed in the last pre-meiotic division as has been suggested. He also finds continuous chromonemata in all stages of the meiotic chromosomes, the leptonema of early prophase in meiosis consisting of two closely intertwined threads. These undergo pairing in the zygotene stages, thus giving four more or less intertwisted strands. The double coiled threads frequently give a false appearance of chromomeres. The pairing of threads appears to begin at the ends simultaneously and proceed towards the median constriction. The four-strand structures thus formed undergo contraction to form the bivalent chromosomes. As regards the relation between meiosis and mitosis, it is concluded that the split which occurs in prometaphase of somatic mitosis is completely suppressed in the heterotypic prophase owing to the pairing of homologous chromosomes. The univalent chromosomes in heterotypic anaphase and telophase have two coiled chromonemata, and each chromonema divides in late prophase of the second division. The meiotic are thus similar to the somatic chromosomes, with the difference that synapsis accompanied by suppression of the late prophase split in the threads effects the reduction in chromosome number.

Growth of Roots. The annual report of East Malling Research Station for 1933 includes a paper by Mr. W. S. Rogers on "Root Studies, (4). A Method of observing Root Growth in the Field, illustrated by Observations in an Irrigated Apple Orchard in British Columbia" (The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report, Twenty-first Year, 1933. Pp. 268 + 14 plates. East Malling: East Malling Research Station, 1934. Free to Associate Members; to non-Members, 4*s*.). Trenches were dug in the ground, about 2 ft. 6 in. away from an apple tree. A piece of plate glass was erected in each trench, at the end nearest the tree, and the soil was dried and replaced. Wooden linings and a roof rendered the trench convenient and light-tight. Roots from the tree grew against the glass, and could be observed and photographed as in the usual 'observation box'. It has been shown that there is a close correlation between the rate of root growth and the temperature of the soil, though lack of sufficient moisture quickly checks root growth. Soil moisture is measured by an ingenious device, the construction of which is briefly described. This method of estimating root activity has several disadvantages, but has the great merit that it allows living roots to be studied under natural conditions.

Occurrence of Sulphides on the Sea Bottom. In the Walvis Bay area, South-West Africa, periodical outbursts of sulphuretted hydrogen occur under the sea, accompanied by widespread destruction of fish and the appearance of floating islands of mud. These are popularly ascribed to submarine volcanic action. Careful examination of the conditions has, however, shown that the gas in all probability owes its origin to bacterial action (Investigational Report No. 3. Department of Commerce and Industries, Fisheries and Marine Biological Survey Division. By W. J. Copenhagen. Pretoria: Government Printer, 1934). The dark green mud of the sea bottom in this area, a sample of which contained 0·12 per cent H_2S, consists largely (60 per cent of the dry residue) of diatoms, the growth of phytoplankton being greatly favoured in this region by the upwelling of water rich in phosphates from the Benguella current which flows northwards from the Antarctic Ocean. The decay of the accumulated debris of these organisms gives rise to sulphuretted hydrogen, part of which is oxidised by the oxygen present in solution in the sea-water, so that anærobic conditions are established which are favourable to the growth of sulphate-reducing bacteria. These in their turn reduce the sulphates of the sea-water, forming sulphuretted hydrogen. The gas accumulates in the mud during the winter and some of it is given off in summer causing the outbreaks described above. Sulphate-reducing bacteria could readily be detected in the mud by the use of Van Delden's medium under anærobic conditions. Black mud also occurs in Cape Town harbour, and this likewise contains sulphate-reducing bacteria; but in this case sufficient iron compounds are present to react with the sulphuretted hydrogen forming ferrous sulphide, so that no accumulation of gas takes place and no outbreaks occur.

Excluding Noise by Means of Double Windows. A very old-fashioned method of excluding street noises is to use double windows. Experiments on the acoustical insulation of rooms and buildings by this method have been made at the National Physical Laboratory. It has been proved that the insulation afforded by a partition of simple construction—a solid brick wall, for example—is determined almost entirely by its weight per square foot of surface. The greater the density of the wall, other things remaining the same, the more effective is the screening. If a room is fitted with single windows, practically all the sound entering it from the street passes through the window-panes. To overcome this drawback, a special investigation has been made at the Laboratory of the acoustical insulation of double partitions and in particular of double windows. The researches show that large changes in the insulation are caused by varying the distance between the windows. It was found that if the separation between the panes of 21 oz. window glass in a double window is only ¼ in., it is possible for a conversation to be carried on between two persons standing on opposite sides of the window. When the separation between the panes was increased to six inches, speech is impossible. The insulation does not always diminish as the space between the windows is increased. In some cases, a little increase was shown at first. This is attributed to a resonance effect, particularly in the lower notes transmitted. The conclusion arrived at is that, if the double window is properly designed, its sound insulation can be even better than that of the wall in which it is built.

Rotary Wing Aircraft. There are many conceivable types of aircraft. In addition to the orthodox aeroplane, we have the helicopter (air screw), the autogiro and the paddle wheel or flapping wing machine. Any combination of two or more of these simple types would be a conceivable machine. In the Year Book of the Cambridge University Engineers' Association, a thoughtful discussion of the subject is given by J. De La Cierva. He points out that there are three types of living creatures that fly. Big soaring birds during most of their flying illustrate the first type, deriving their lift from the translational motion only. Amongst man-made aircraft, aeroplanes and most flapping wing machines belong to this class. In the second type, there are the smaller birds which derive their lift partly from the translational motion and partly from a relative motion between wings and body. Autogiros, certain helicopters and paddle machines illustrate this class. The third type includes insects, which derive their lift mostly from a relative motion between wings and body. A comparison is given of the relative merits of aeroplanes on one side and autogiros, helicopters and paddle machines on the other, taking into account their efficiency, the use to which they can be put, piloting, safety, simplicity and cost. For speeds greater than some 250 miles per hour, the speed of sound will be approached by points of the rotary wings of autogiros and helicopters, and it is likely that some drop in efficiency will occur. The author considers it likely that the rocket aeroplane will be the fastest of flying machines which can ever be built, since tractor air-screws will suffer from the same limitations as autogiros at high speed. In his opinion, the best all-round flying machine in practice is the autogiro.

Electrical Properties of Soil at very High Frequencies. R. L. Smith-Rose and J. S. McPetrie have recently described in two papers some measurements made on the electrical properties of soil which affect the propagation of wireless waves of lengths 1·5 metres and less (*Proc. Phys. Soc.*, Sept.). Field tests were made with a transmitter and receiver mounted on a post vertically above one another. As the transmitter and receiver are moved up and down, the distance between them being kept constant, the receiver current varies periodically on account of the interference between the direct waves and those reflected from the ground. The reflection coefficient may be estimated from the maximum and minimum current readings, and the phase change on reflection may be found by observing the change in the position of the interference pattern when the ground is covered by a 'perfect conductor' of copper gauze. The dielectric constant of the soil lies between 7 and 16 at 1·5 m. and the conductivity is less than 10×10^8 E.S.U. Measurements were also made at 0·46 m. wave-length. Laboratory tests were made by packing soil round a Lecher wire system excited by a magnetron oscillator at 1·5 m. The position of the nodes on the wires outside the box was followed continuously as the soil was added and the wave-length in the soil could be deduced. It is difficult to separate the conductivity and dielectric constant in these experiments, but useful limits can be obtained for the quantities, and their variation with moisture content was investigated. The results are in satisfactory accord with the experiments made in the field.

Potassium Nitrate. Miscellaneous Publication 192 of the United States Department of Agriculture (Washington, D.C. Government Printer. 5 cents) is entitled "A Review of the Patents and Literature on the Manufacture of Potassium Nitrate with Notes on its Occurrence and Uses", by C. W. Whittaker and F. O. Lundstrom. It contains a historical sketch and statistics of the saltpetre industry, the various methods of production of potassium nitrate and its uses as a fertiliser and also a bibliography of literature and patents. The literature on this subject is rather scattered and the publication gives a brief and useful review of the information.

Disulphur Decafluoride. The main product of the action of gaseous fluorine on sulphur is the hexafluoride, SF_6, which is a very stable gas. Other fluorides of sulphur which have been described are S_2F_2 and SF_4. By the fractionation of a large quantity of the hexafluoride prepared by passing fluorine over sulphur, K. G. Denbigh and R. W. Whytlaw-Gray (*J. Chem. Soc.*, 1347; 1934) have obtained a new compound, disulphur decafluoride, S_2F_{10}, melting at $-92°$ and boiling at $+29°$. It is stable, but not so inert as SF_6. Only small quantities are produced, although the yield is somewhat improved by using plastic instead of rhombic sulphur. The vapour density and some physical properties were measured and they are in agreement with the simple formula in which sulphur is sexacovalent, the two sulphur atoms being linked together and each with five atoms of fluorine, all by single bonds. Some difficulty was experienced in the preparation owing to the presence of carbon fluorides in the fluorine, derived from the carbon anode of the cell containing potassium hydrogen fluoride. These were removed by passing the fluorine through a tube cooled in liquid oxygen.

Geology in Great Britain

PART I of the "Summary of Progress of the Geological Survey of Great Britain" for 1931[1] contains the usual annual reports of the Geological Survey Board and of the Director and gives particulars of routine work carried out during the year under review. Fifty-four maps were issued, together with four English and two Scottish memoirs, all of which have already been noticed in our columns (NATURE, 131, 370–372; 1933). Part 2[2] contains a series of papers on subjects of special interest. The Carboniferous system receives particular attention, D. A. Wray dealing with the Yorkshire Coal Measures and S. W. Hester with the Millstone Grits of North Staffordshire, while Stanley Smith, R. Crookall and W. S. Bisat discuss palæontological problems. C. B. Wedd contributes notes on the Ordovician of Montgomeryshire and an important study of Palæozoic and later tectonic structures between the Longmynd and the Berwyns. Three new species of Old Red Sandstone fishes are described by D. M. S. Watson. Petrology is represented by two highly interesting papers: one by Sir John Flett on the Stankards Sill, a teschenite-picrite intrusion in which differentiation was accomplished either before or during intrusion; the other by A. G. MacGregor and W. Q. Kennedy on the Morvern-Strontian 'granite', a complex of the appinite-lamprophyre suite followed by tonalites, granodiorites and biotite-granite.

Part I of the "Summary" for 1932[3], in addition to the usual information, records the plans for displaying exhibits in the New Museum of Practical Geology at South Kensington, plans that are now being actively put into operation. New models have been constructed to show the relation of geological structure to surface features in several characteristic British regions, and panoramic displays designed to illustrate geological processes and mining geology. Maps issued in 1932 numbered 59 and there were published five English and three Scottish memoirs some of which have been noticed already (loc. cit.) while others, together with some that have since appeared, are briefly reviewed below.

In Part 2[4] Sir John Flett describes the important changes in the interpretation of the geology of Meneage rendered necessary by critical discoveries made in recent years. Three important contributions to the geology of the Kent Coalfield are made by H. G. Dines (sequence and structure), R. Crookall (fossil flora) and C. J. Stubblefield (fossil fauna). Other palæontological papers are by Gertrude L. Elles on the Lower Ordovician graptolites with special reference to the Skiddaw Slates and by S. H. Straw on a Palæozoic fauna revealed by the Little Missenden boring; Sir Arthur Smith Woodward reports on the fish remains of this fauna. E. E. L. Dixon describes the Gault of Cambridgeshire. An example of composite auto-intrusion in a Lower Carboniferous lava-flow (mugearite and trachyandesite) provides W. Q. Kennedy with a petrological problem of a new type.

The memoir on the Cheviot Hills[5] (Sheets 3 and 5) replaces two smaller ones issued in 1888 and 1895, and deals with an area of special interest since it includes a deeply dissected volcano of Old Red Sandstone age, laid open by long exposure to erosion. Violent eruptions broke through a land-area of intensely folded Silurian sediments and these were followed by the outpouring of andesitic lavas. After a pause, activity was resumed with the intrusion of granite. The rock is normally a pink granophyric type, but varieties produced by the absorption of earlier and more basic rocks are not uncommon. There was much tourmalinisation towards the north and west, and ramifying strings of felsite were injected as the granite consolidated. Two well-marked dyke-swarms followed, this final episode also closing with felsitic veins. After long denudation, Carboniferous rocks overlapped against the Cheviots and with them was associated a renewal of volcanic activity. Later igneous action is represented by late-Carboniferous dykes and by the Acklington dyke of Tertiary age. The Jurassic and Cretaceous periods have left no trace. The glaciology of the region, rich in phenomena connected with the retreat of the last great ice-sheet, receives full treatment.

Under the general title of "Economic Geology of the Ayrshire Coalfields" a series of four memoirs has now been issued. The first two dealt with north Ayrshire and appeared in 1925. The third is devoted to the Mauchline Basin and the coalfields to the west and east, and was published in 1930. The present volume[6] is the last of the series and is concerned with the southern portion of the field, which includes the Carboniferous Limestone Coals of Dailly and Patna and the important seams in the Coal Measures of Dalmellington and New Cumnock. Extensive outcrops of Ordovician, Silurian and Old Red Sandstone rocks border the area everywhere save along the northern margin. The Calciferous Sandstone, Carboniferous Limestone, and Coal Measure Series follow in upward succession. Preliminary correlations of the Coal Measures by means of 'mussel' zones are made with the English equivalents. A striking feature is the series of powerful faults crossing the country in a north-east direction, probably determined by the strike of the axes of the compressed folds in the older Palæozoic rocks that underlie the district. Igneous activity is represented by Permian sills, dykes and vents and by Tertiary dykes.

The Central Coalfield of Scotland has been divided into nine areas, to each of which a separate memoir has been assigned. Area III[7], dealing with the country around Bo'ness and Linlithgow, is the eighth in order of issue, and the series will be completed by the memoir on Area I now in preparation. The region now described drains entirely to the Firth of Forth. Calciferous Sandstone sediments occur in the south-east and are followed in regular succession to the west by the Carboniferous Limestone Series (including the Limestone Coal Group), the Millstone Grit, and the Productive Coal Measures. The main complications as regards structure arise from the great thicknesses of volcanic rocks that occur locally, most of these falling within the limits of the Carboniferous Limestone. Sills, dykes and vents represent related intrusions, the later quartz-dolerites being assigned to a Permo-Carboniferous age. Mining of coal from the Limestone Coal Group has been carried on in the Bo'ness field for several centuries, and the landward coal is now nearly exhausted. Special sections deal with recent mining developments underneath the Forth and with the concealed coalfield below the Millstone Grit and Coal Measures to the west. Glaciation and the superficial deposits receive detailed attention and also such economic

materials as building stone, fireclay, limestone and road metal.

Leaving the north, we turn to a memoir[8] describing the country to the south and south-east of Cambridge (Sheet 205), a district almost wholly devoted to agriculture and most of it but thinly inhabited. The solid rocks exposed are of Cretaceous age, from the Gault to the Upper Chalk, but the Lower Greensand, which yields good supplies of water, has been reached in many well-borings in the north-west. The greater part of the memoir deals with the Pleistocene and other superficial drifts. In addition to glacial gravels and boulder clays and fluviatile terrace gravels and alluvium, a series of deposits termed 'Taele Gravels' is distinguished. The word 'Taele' is used in Denmark and Norway to signify deeply frozen ground, and by the melting of this, coupled with heavy precipitation, the mud-flows and washed and bedded gravels of these deposits have probably been formed. The glacial history is of great complexity and as final conclusions cannot as yet be reached, the alternative views are fairly presented. Records of several new wells are included and contoured maps are given showing the water-table in the Chalk in 1928 and 1929.

The memoir describing the well-known country around Reigate and Dorking[9] (Sheet 286) is likely to make a wide appeal since it extends from Epsom across the North Downs to Leith Hill and is a picturesque and favourite residential district within easy reach of London. The geological structures epitomise those found throughout the Wealden area. Though the regional dip corresponds to the gentle flexure of the Weald dome, the structure is locally complicated by subsidiary folds, generally monoclinal, in which steeper dips, sometimes nearly vertical, occur. Details of these are clearly described. The solid formations range from the Lower Cretaceous Tunbridge Wells Sand to the Eocene Bracklesham Beds, and due attention is given to the scanty Pliocene remains and to the Pleistocene and Recent superficial deposits. Economic aspects are dealt with somewhat fully, especially water supply and fullers' earth. The latter, as prepared at Nutfield, excels in quality to such a degree that it forms a standard by which other varieties are gauged. A noteworthy chapter is devoted to the scenery and drainage systems of this attractive countryside.

The Cirencester memoir[10] is descriptive of Sheet 235 and is a notable contribution to the geology and geography of the Coteswolds by an author distinguished for his researches on these classic hills. Apart from the superficial deposits, which do not make extensive spreads, the formations are wholly Jurassic, ranging from the Lower Lias to the Oxford Clay. Just off the map the Palæozoic floor was reached in a boring near Burford Signet. A valuable part of the memoir is that on agriculture by Prof. J. A. Hanley. Not only is this a contribution of interest to agriculturists and soil investigators, but also to botanists, since it contains many references to the connexion between the flora and the parent rocks. Questions of water supply are discussed but briefly, as this topic has already received detailed treatment in the "Wells and Springs of Gloucestershire" issued by the Survey in 1930.

The memoir on the Holmfirth and Glossop district[11] (Sheet 86) covers part of the high moorland (north of the Derbyshire Dome) of the Southern Pennines, everywhere formed by the Millstone Grits, and the adjoining portions of the coalfields of Yorkshire and Lancashire-Cheshire. Full use has been made of recent advances in our knowledge of the palæontology of the Millstone Grits and, as a result, the structure of the area has been worked out in great detail. It is of interest to find that the structural disturbance which divides the Yorkshire Coalfield into two parts, the West and South Yorkshire fields respectively, can be traced far back into Millstone Grit times. The beds thicken both north and south from the neighbourhood of Hepworth and Denby Dale, showing that movement was taking place contemporaneously with their deposition. Much new information is also given of the non-marine lamellibranchs of the Coal Measures. During Glacial times, this part of the Pennines lay between the great ice sheets of the east and west and was practically unglaciated, and in consequence it is a region of special interest to botanists and archæologists.

The Torquay memoir[12], which is a second edition, revised after thirty years, embraces such well-known South Devon localities as Paignton, Totnes and Dartmouth, as well as Torquay itself (Sheet 350). The area includes a diversified stretch of picturesque coastline, famous for its fine sections of Devonian and New Red rocks, and many of these are effectively illustrated by photographs and line-drawings. The general correlation of the sub-divisions of the Devonian with those of the Continent may now be regarded as established, correspondence with the German type being closer than with the Franco-Belgian type. Igneous rocks have a wide distribution, particularly in the Ashprington district. Spilitic lavas are common and most of the intrusions are albitised dolerite; quartz-keratophyres occur, but are relatively infrequent and have their chief development in the Lower Devonian. Pleistocene phenomena are well represented by bone caverns, including the famous Kent's Cavern, raised beaches, and the submerged forest bordering the shores of Tor Bay. Notable new features are the petrology of the igneous rocks, the palæontology of the Lower Devonian and the treatment of the soils and agriculture of the area. This memoir, like some of the others described above, should be of special value to students and others taking part in geological excursions.

[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1931." Part 1. Pp. iv+81. 1*s*. 6*d*. net.

[2] *Ibid.* Part 2. Pp. vi+166+4 plates. 3*s*. net.

[3] *Ibid.* for the year 1932. Part 1. Pp. iv+98. 2*s*. net.

[4] *Ibid.* Part 2. Pp. iv+142+10 plates. 3*s*. net.

[5] "The Geology of the Cheviot Hills". By R. G. Carruthers, G. A. Burnett and W. Anderson, with Petrological Notes by H. H. Thomas. Pp. xi+174+7 plates. 4*s*. net.

[6] "Economic Geology of the Ayrshire Coalfields, Area IV (Dailly, Patna, Rankinston, Dalmellington and New Cumnock)." By J. B. Simpson and A. G. MacGregor, with contributions from J. E. Richey and V. A. Eyles. Pp. viii+167+3 plates. 3*s*. 6*d*. net.

[7] "Economic Geology of the Central Coalfield, Area III (Bo'ness and Linlithgow)." By M. Macgregor and D. Haldane. Pp. vi+128+1 plate. 3*s*. net.

[8] "The Geology of the Country near Saffron Walden". By H. J. Osborne White, with contributions by F. H. Edmunds. Pp. xii+126+5 plates. 3*s*. net.

[9] "The Geology of the Country around Reigate and Dorking". By H. G. Dines and F. H. Edmunds, with notes by H. Dewey and C. J. Stubblefield, and a chapter on palæontology by C. P. Chatwin. Pp. vii+194+5 plates. 4*s*. net.

[10] "The Country around Cirencester." By Linsdall Richardson, with contributions by J. A. Hanley and H. G. Dines. Pp. xi+119+7 plates. 3*s*. net.

[11] "The Geology of the Country around Holmfirth and Glossop." By C. E. N. Bromehead, Wilfrid Edwards, D. A. Wray and J. V. Stephens, with notes by G. V. Wilson and W. Lloyd. Pp. xii+194+5 plates. 4*s*. net.

[12] "The Geology of the Country around Torquay." By W. A. E. Ussher. Second edition (revised). By W. Lloyd, with palæontology by C. P. Chatwin, and a chapter on the petrography of the Igneous Rocks by W. G. Shannon. Pp. xiii+169+7 plates. 4*s*. net.

London: H.M. Stationery Office, 1932–34.

Scientific Research and New Uses for Coal*

IT is frequently stated that the lessened demand for coal is due partly to its more economical use, partly to the great extension in the use of gas and electricity, and partly to the harnessing of water-power. Nothing could be more erroneous. The more economical use of a commodity, as Prof. Jevons has shown, does not, as is commonly supposed, lead to a restriction in its consumption. Every economy in the production and consumption of an essential commodity, if duly reflected in its selling price, will increase the public demand. That is emphatically so in the case of fuel. People do not keep windows closed in Great Britain because they prefer stuffiness to air, but for warmth. Our climatic conditions are such that for two thirds of the year there is a large unsatisfied demand for fuel in Great Britain.

As with fuel, cheapening the cost of power leads to its more extensive consumption. Take the case of Italy. It was stated when Italy set about developing her considerable latent resources of water-power, owing to the high price of coal in 1918–20 (coal was sold in Genoa at £7 10*s*. 0*d*. per ton after the Armistice), that the importation of coal would decrease materially.

The reverse has proved to be the case, as the following figures show :

Year	Imports of Coal and Coke : tons	Home production : tons
1913	10,659,890	266,552
1919	6,093,776	2,368,068
1929	14,272,147	945,000
1931	10,911,657	590,701

It is fifteen years since Sir George Beilby, Sir Charles Parsons, myself, and Mr.—later Sir—Richard Thelfall signed the Report on Gas Standards, in which we stated that "The national interests will best be served by that policy which will promote the widest adoption of scientific methods for the preparation and use of fuel". There are prospective developments—what are commonly termed 'new uses' for coal—which are under constant and intensive examination, though it cannot yet be said positively —with one possible exception—that they are able to stand on their own feet. The prospective developments I have in mind are :

(1) The hydrogenation process.
(2) Low-temperature carbonisation of coal.
(3) The use of gas in transport in place of petrol.

I refer, in particular, to the turning of coal into oil, namely, the wider application of the low-temperature carbonisation of coal, with the consequent production of tar suitable for burning under boilers, or the hydrogenation of this resultant tar in order to secure a home supply of petrol of the first quality; or, alternatively, the treatment of the tar so as to render it available for use in Diesel engines. I prefer to regard the hydrogenation process as, at present, applicable rather to the treatment of tar than to the direct treatment of coal.

In view of the increasing use of smokeless semi-coke resulting from the low-temperature distillation of suitable coals, it is worth while to pause for a few minutes and consider what would be the result of its substitution on the grand scale for raw coal in our homes. Great Britain is at present practically dependent upon foreign countries for its supply of fuel-oil and of petrol, and from this point of view alone it would appear that the development of a home source is of great importance. There is also the fact that were the low-temperature carbonisation of coal to become established, it would undoubtedly contribute to an increase in the production of coal and to greater employment in many directions.

As indicative of the possible bearing that the application of these methods may have upon the coal industry, I would point to the domestic consumption of raw coal, which amounts to about 35 million tons per annum. If the whole of this demand were met by the semi-coke produced by low-temperature carbonisation, there would result :

(1) An augmentation in the national output of coal amounting to about 12 million tons per annum.
(2) The production annually of the following alternative products : (*a*) 2 million tons of tar-oil for fuel purposes ; (*b*) 1½ million tons of Diesel engine oil ; (*c*) 358 million gallons of petrol.
(3) The production annually of 100 million gallons of petrol by stripping the gas.
(4) An increase in the employment of miners of 35,000-45,000 men, with a consequent annual saving in unemployment benefit.
(5) Increased employment at low-temperature carbonisation works.

The quantity of fuel-oil obtained would be more than sufficient to meet the peace requirements of the Royal Navy ; or, if subjected to full hydrogenation, 358 million gallons of petrol would be produced which, with the 100 million gallons obtained from the gas, would amount to about half the quantity imported during 1932.

Even if it were not found practicable to carbonise the whole of the 35 million tons of domestic fuel for the above purposes, owing possibly to the competition that would arise due to the increasing use of electricity and gas for domestic purposes, it is useful to record that there should still be forthcoming the following advantages :—(1) A considerable augmentation in the output of coal due to the increased demand for semi-coke, electricity and gas. (2) The production of at least enough tar for fuel purposes, or, alternatively, of Diesel oil or petrol for power purposes, to enable Great Britain to have a reasonable home source of these products, and one capable of expansion in times of national emergency. (3) An increase in employment of workers.

The semi-coke, as is well known, produces a more efficient open fire than raw coal, with the definite added advantage that it is smokeless. In the words of Sir Frank Smith in his Norman Lockyer lecture of last year, "It should not be forgotten that the damage done by smoke to the nation's health and to our buildings must be reckoned in tens of millions of pounds per annum ; smokeless fuels, including gas and electric power, show us the way out."

The low-temperature distillation process seems to be in a fair way to becoming a stable industry, for the year 1929 saw the establishment in England of the first distillation plant in the world devoted solely to the distillation and fractionisation of low-temperature coal-oil. In 1930 occurred the first full-scale experiments with aeroplanes flying on coal-petrol, and in 1932, for the first time, vessels of the British Navy

* From the presidential address to the Institution of Civil Engineers, delivered by Sir Richard Redmayne on November 6.

put to sea fuelled only with oil made from British coal. 1933 saw a number of home-defence aircraft, flying daily, actuated by coal-petrol alone, and also, for the first time, large cargoes of low-temperature coal-oil distillates were shipped to foreign countries.

Another possible method of increasing the consumption of coal is in the larger production of gas owing to its use in the compressed form for motor transport. A committee which has been considering this matter for many months past recently published the results of the experimental work so far completed. From those results it is quite evident that the technical problems involved in the substitution of gas for liquid fuel have been solved. For more than a year, such vehicles have been running continuously and successfully upon compressed gas. It has been found that 250 cubic feet of gas of a calorific value of 500 B.Th.U. per cubic foot (that is, 1¼ therm) is equivalent to a gallon of motor spirit.

In a report of a series of exhaustive tests made with a lorry owned by the Whitwood Chemical Company, Ltd., of Normanton, and extending to about 670 miles, it is stated that the consumption of fuel was 9,400 cubic feet of gas and 27 gallons of low-grade oil. Based on the data obtained from this trial, it is possible to give the comparative costs of petrol, oil and enriched gas, as follows :—

Total All-in Costs per Mile for Varying Mileages per Annum

Miles per annum	Petrol (pence)	Oil (pence)	Gas (pence)
5,000	19·54	19·54	18·41
10,000	12·18	11·62	11·05
15,000	9·73	8·98	8·60
20,000	8·50	7·66	7·37
30,000	7·27	6·34	6·14
40,000	6·66	5·68	5·53
50,000	6·29	5·28	5·16

Developments in the use of producer gas, electricity, and steam for motor transport have also made great strides. A strong case could be made out for the sole use in our large towns of electric taxis, with the beneficial results of cessation of noise and deleterious fumes, for it is possible now to run a Morrison electric car for 40 miles without recharging, doing 2½ miles per unit of electricity. Each such vehicle daily at work means in electricity consumption alone 3 days' work per annum to a miner. For long-distance, heavy-goods transport, the steam-driven lorry, year in year out, is probably the cheapest motor for the purpose on the road.

University and Educational Intelligence

CAMBRIDGE.—At the Congregation of the Senate on November 17, a grace will be submitted approving the conferment of M.A. *honoris causa* upon Prof. William P. Wynne, emeritus professor of chemistry in the University of Sheffield, who is engaged on research work at Cambridge.

The Cavendish Professor of Experimental Physics gives notice that the Clerk Maxwell scholarship will become vacant on December 25. Candidates are requested to send in their applications to Lord Rutherford at the Cavendish Laboratory on or before December 1.

THE annual meeting of the Science Masters' Association will be held at Oxford on January 1–4, under the presidency of Dr. N. V. Sidgwick, reader in chemistry in the University. The following lectures will be given during the meeting : C. N. Hinshelwood, "Some Aspects of Modern Physical Chemistry" ; Prof. H. H. Plaskett, "The Physics of Astronomical Vacua" ; R. B. Fisher, "Tissue Respiration" ; Dr. W. O. James, "Plant Respiration" ; Prof. J. S. E. Townsend, "Ionisation by Collision" ; Prof. R. Robinson, "The New Aspect of the Elementary Theory of Organic Chemistry" ; Dr. K. J. Franklin, "X-Ray Photography of the Circulation of the Blood" (with cinematograph films). A discussion on scholarship examinations will also be held. Further information can be obtained from Mr. H. G. Lambert, Shirley Corner, Boden Road, Hall Green, Birmingham.

THE Battersea Polytechnic's report on the session 1933–34 shows a total enrolment of 3,156, a slightly larger number than in the preceding year. About one sixth of the students attended full-time day courses, chiefly in domestic science (250), engineering (115) and hygiene (47), the remaining five-sixths being evening class students, chiefly of engineering (2,231), chemistry (1,009), domestic science (758), hygiene (742), mathematics (586) and physics (578). In view of the ever-increasing use of electric power for domestic purposes, it is surprising that the classes in 'electrical housecraft' were attended by only 8 students. This year the Electrical Association for Women is lending its kitchen for training purposes. A table of occupations followed by students shows : clerical 608, engineering 533, chemistry and physics 279, sanitary inspectors, etc. 180, teaching 166, domestic service 102, dressmaking, etc. 53, food production 51, shop-assistants, etc. 38, other occupations 137, students only 579, retired and unoccupied 250. A 'follow-up' of former students (mainly day-students) shows the following numbers of posts obtained during the past ten years : 878 posts requiring domestic science qualifications, 327 as sanitary inspectors, etc., 252 as engineers, 206 as chemists, scientific assistants, science teachers, etc., 79 as art and handicraft teachers or practitioners. A students' union was instituted during the past year.

ADULT education is developing and expanding in the United States of America as a result of certain phases of the President's "New Deal". In the May issue of *School Life*, devoted chiefly to summer schools and holiday tasks, is published an article on schools for workers, giving some account of how the Federal Government is co-operating with organisers of workers' educational associations and trade unions in experimental courses preparatory to launching a campaign for a wide extension of adult education classes. Among the subjects studied in these classes for workers are : the economic position of the United States, the labour movement abroad, English and public speaking. The teaching is on the lines of the regular summer-school courses. An editorial forecast assigns to universities of the future the task of providing at minimum costs for summer holiday activities combining learning and recreation for old and young in camps in national parks. At present, the summer-session programmes are too generally limited to meeting the demands of students who want to work for more 'credits'. The same issue quotes a recent appreciation of American educational methods by Prof. A. Einstein, giving first place to the negative virtue of non-interference with personal initiative, independence and joy of living and the urge for knowledge.

Science News a Century Ago

Holland's Oxy-Hydrogen Microscope

The *Times* on November 20, 1834, announced that "Mr. Holland's very entertaining and very scientific exhibition is reopened this day for the season. We were present at a private view last night of the wonders which it presents to the eye. It has undergone many improvements since it was before open to the public, and may, we believe, now be considered what its proprietor states it to be, the largest, most powerful and most distinct microscope in the world. The disc contains 254 square feet and the objects, both animate and inanimate, are variously magnified from a power of 9,000 to a power of 2,624,400 times their actual dimensions. . . . Among the most curious phenomena presented to the eye are the aquatic larvæ, in some of which, so pellucid is the whole internal structure, that the intestinal canal and the peristaltic motion are clearly perceptible. . . ."

Darwin in the Island of Chiloe

During the whole of October 1834, Darwin was confined to his bed at the home of his old schoolfellow and friend, Mr. Richard Corfield, of Valparaiso; but at the beginning of November he was able to rejoin the *Beagle*. On November 10, he records, the *Beagle* sailed from Valparaiso to the south, for the purpose of surveying the southern part of Chile, the Island of Chiloe, and the broken land called the Chonos Archipelago, as far south as the Peninsula of Tres Montes. On November 21, the ship anchored in the bay of San Carlos, the capital of Chiloe, and a day or two later Darwin hired horses to take him to Chacao at the northern extremity of the island. On November 26, he records: "The day rose splendidly clear. The volcano of Osorno was spouting out volumes of smoke. This most beautiful mountain, formed like a perfect cone, and white with snow, stands out in front of the Cordillera. Another great volcano, with a saddle-shaped summit, also emitted from its immense crater little jets of steam. Subsequently we saw the lofty-peaked Corcovado—well deserving the name of 'et famoso Corcovado'. Thus we beheld, from one point of view, three great active volcanos, each about seven thousand feet high. In addition to this, far to the south, there were other lofty cones covered with snow, which, although not known to be active, must be in their origin volcanic".

Thomas Hawkins's *Ichthyosaurus*

The geologist Thomas Hawkins, 1810–89, was best known for his collections of fossils from Devon, Somerset and Dorset, some of which were acquired by the British Museum while others were presented by him to Oxford and Cambridge. His "Memoirs of Ichthyosauri and Plesiosauri" was published in 1834, and in the *Times* of November 21 of that year a correspondent directed attention to the delay of the authorities of the British Museum in placing on exhibition that extraordinary fossil animal "The Ichthyosaurus Chiroligostinos" of Mr. Hawkins, or "the Viery Dragon that stinged Moses" of the Dorsetshire quarrymen. "I was informed by one of the servants in the Museum," says the writer, "that cases were ordered for Mr. Hawkins's collection and that possibly the Ichthyos might be exposed in February. Fully acknowledging the propriety of its being placed in an additional case, I must protest against the absurdity of its remaining concealed till then. It is not liable to suffer from dust, or a slight touch, and to prevent persons meddling with it, for a few shillings a slight bar might be placed in front of it. . . . There seems to be a strange want of proper management, or something worse than that, on the part of some person or persons connected with the Museum, but whether it rests with Mr. Koenig or a higher authority I cannot say." Charles Dietrich Eberhard König (1774–1851) was the keeper of the Mineralogical Department.

Societies and Academies

London

Royal Society, November 8. A. C. G. EGERTON and F. LL. SMITH: Estimation of the combustion productions from the cylinder of the petrol engine (1). An engine was fitted with a valve so that gases could be extracted at any stage during the compression and working stroke. By analysis of the gas it was confirmed that 'knock' is associated with accelerated flame velocity, but only in the last portion of the gas to burn. Some combustion occurs in the neighbourhood of the valve prior to arrival of flame. The aldehydes reach their maximum concentration (1 in 500) at the moment when flame reaches the valve, the substances behaving as peroxide (1 in 10,000) slightly earlier. Aldehydes were not responsible for the production of 'peroxide' or the 'knock'. Certain organic peroxides were found to be powerful 'pro-knocks'. A. C. G. EGERTON, F. LL. SMITH and A. R. UBBELOHDE: Estimation of the combustion products from the cylinder of the petrol engine (2). The experiments were extended to the study of the behaviour of different hydrocarbons and other kinds of fuel, the 'aldehyde'—a 'peroxide'—formed at various stages being determined by special methods. The substance behaving as peroxide is mainly nitrogen peroxide and the peak in the curve of concentration which occurred before the top dead centre is partly explained by the presence of traces of sulphur. Nitrogen peroxide alone does not act as a pro-knock, whereas organic nitrites are strong pro-knocks. Nitrogen peroxide is, however, formed in greater amounts under knocking conditions and quite early in the stroke. A. R. UBBELOHDE and A. C. G. EGERTON: Estimation of the combustion products from the cylinder of the petrol engine (3). The behaviour of various types of organic peroxides towards various reagents was investigated. By taking advantage of the different rate of reaction of the various peroxides on potassium iodide, it was possible to determine them in presence of nitrogen peroxide. Diethyl and ethyl hydrogen peroxide and acetyl peroxide were found to be violent pro-knock substances. The mol fraction needed to produce pronounced knock was 10^{-5}. A peroxide of apparently similar type to ethyl hydrogen peroxide was detected in the gases from the engine cylinder when run under knocking conditions on pure paraffin hydrocarbons in much the same concentration. H. JONES: Application of the Bloch theory to the study of alloys and of the properties of bismuth. A qualitative explanation is given of the variations of the crystal parameters within the ε and η phases observed by Owen and Pickup, and also of the electron-atom ratio at which the ε phase begins (Hume-Rothery's rule). A Brillouin zone is found for bismuth containing five electrons per atom. The theory shows why bismuth

does not form a co-ordination lattice. The conductivity of alloys of Bi, Sn, and Bi Pb are considered; the observed variation with composition leads to a determination of the 'overlap' of the Fermi surface into the second zone. From this the diamagnetism of pure bismuth and of Bi Sn, Bi Te alloys are deduced, as is also the magnetostriction, in good agreement with experiment.

PARIS

Academy of Sciences, October 15 (*C.R.*, **199**, 689–744). J. COSTANTIN: The influence of high latitudes on the agricultural yields of the potato in North America. The use of phytopathological certificates (as in Canada) is a powerful factor in increasing the yields of the potato. The facts quoted tend to prove that high latitudes tend to increase the yield and reduce disease. WLADIMIR VERNADSKY: Should heavy water be looked for from the geochemical point of view? A general discussion of the possible increase in the proportion of heavy water during geological periods. EDOUARD CHATTON and ANDRÉ LWOFF: A parasitic infusorian of the secreting hairs of Edriophthalm Crustacea and the new family of the Pilisuctoridæ. ALBERT TOUSSAINT: Contribution to the study of the interactions between the sustaining wings when 'taxi-ing'. The application to the case of biplane cells. EMILE SEVIN: Waves, spin and numbers. MAURICE PAUTHENIER and LÉON AGOSTINI: The law of charge of a spherical particle in an ionised field. The theoretical expression for the limiting charge, $3Ea^2$ (E is intensity of ionised field and a the radius of the sphere), has been tested experimentally. When the velocity of the sphere reaches half that of the ions, the expression is verified to within 3 per cent. PIERRE JOLIBOIS: The electrolysis of saline solutions with distilled water electrodes. A method of electrolysing salts is described giving a separation into basic and acid oxides without any metallic deposit. VASILESCO KARPEN: An electric battery utilising the energy of oxidation of alcohol. A modification of the Becquerel battery formed of solutions of caustic soda and of nitric acid, separated by a porous partition, with platinised electrodes. Methyl alcohol is added to the solution of caustic soda and this is oxidised to sodium formate during the action of the cell. AUREL JONESCO: The absorption spectrum of acetylene in the region 2350–2050 A. BENJAMIN BLOCH and JACQUES ERRERA: The influence of temperature on the absorption of organic liquids in the near infra-red. AUGUSTE ROUSSET: The experimental study of the critical opalescence of binary mixtures. Measurements were made on six mixtures. The theory of Ornstein and Zernike was not found to be verified by any of the six, but the diffusion in three cases is in perfect agreement with Rocard's theory. GEORGES BRUHAT and PIERRE GRIVET: The use of naked compensators in the analysis of elliptical vibrations. HUBERT FORESTIER and GEORGES GUIOT-GUILLAIN: A new ferromagnetic variety of ferric oxide. WILFRIED HELLER: The alteration of hydrophobe sols by the action of light in relation with their natural stability. MAURICE LAMBREY: The decomposition velocity of some nitric esters at a low temperature. Experiments on gun-cotton stabilised either by prolonged boiling with water or by Muraour's method. The initial production of nitric oxide is due to traces of impurities: after the impurities have been decomposed, a measurable decomposition of the pure product takes place at 43° C. It corresponds to the destruction of a thousandth of the gun-cotton in eleven hundred years. ANDRÉ SANFOURCHE: The oxidation of silicon at low temperature. The attack of various specimens of silicon by hydrofluoric acid has been attributed to the removal of a skin of silica formed by oxidation. Direct analysis of samples of silicon prepared by different methods supports this view. DIMITRE IVANOFF: The constitution of M. Delacre's dypnopinacone. CHRISTOPHE GAUDEFROY: The surface of double refraction and the singular property of certain crystalline plates. ADRIEN DAVY DE VIRVILLE: The principal types of shallow pools of the Atlantic shore. ANTOINE MAGNAN, CLAUDE MAGNAN and ALBERT DE VILLELONGUE: Contribution to the study of the vision of fishes. Measurements of the refractive indices of various transparent media of the eyes of fishes. MLLE. EDNA HARDE and MARCEL PHILIPPE: Observations on the antigen power of the mixture diphtheric toxin and vitamin C. CONSTANTIN LEVADITI and MLLE. YVONNE MANIN: The mechanism of the spirochæticidal action of bismuth. C. MATHIS, J. LAIGRET and C. DURIEUX: Three thousand vaccinations against yellow fever in French Western Africa by means of living mouse virus, attenuated by age. Vaccination against yellow fever, by the method of the Tunis Pasteur Institute, has been carried out on a large scale in French Western Africa. Out of a total of more than three thousand inoculations, there were only two severe reactions and these were rapidly cured. There was a high percentage of positive immunisations.

BRUSSELS

Royal Academy of Sciences (*Bull. Class. Sci.* Nos. 8–9). J. E. VERSCHAFFELT: The Bridgman effect. Thermodynamical theory is applied to the case of circuits containing crystalline wires differently orientated with respect to their crystal axes. Electrocalorific effects, which obey the same laws as the Peltier effect and agree with those found experimentally by Bridgman, are shown to exist. P. BURNIAT: Birational transformations of space having two isolated associated fundamental points. R. PIRARD: On an involutory birational transformation of space. MLLE. Y. DUPONT: Electromagnetic couples and angular momenta in the gravific of Th. De Donder. J. WOUTERS: The Raman spectrum of carbon bromotrichloride. The Raman spectrum of $BrC.Cl_3$ consists of six lines, $\Delta\nu = 774$, 715, 425, 295, 247, 195 cm.$^{-1}$. These frequencies are compared with those of other compounds of the general formula ZXY_3, such as $HCCl_3$, $HSiCl_3$, $BrSiCl_3$. M. GONZE: Mechanism of the oxidation of hydrazines by iodine. The reaction between hydrazines and iodine is monomolecular with respect to hydrazine and iodine, and is independent of the hydrogen ion concentration. The observed anomalies in the velocity constant are explicable by the fact that the reaction takes place via free iodine and I_3' ions. M. GONZE: Preparation of *m.m'* trifluorhydrazotoluene. By preparing *m.m'* trifluorhydrazotoluene and *m.m'* hydrazotoluene, it was shown that the substitution of hydrogen by fluorine greatly increases the stability of the hydrazine. A. J. J. VANDE VELDE: The sterilisation of biological powders (5). It is possible to sterilise arable soil completely without appreciably influencing its biological properties by treating it with carbon disulphide at the boiling point (46° C.). The process is repeated three times, the liquid being removed each time by spontaneous evaporation.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 2). N. MUSCHELISHVILI: A discussion of new integral problems of the theory of elasticity in two dimensions. D. KRUTOV: The Picard-Landau problem. V. FESENKOV: Stability of the photometric scale for the focal images of stars. Y. KRUTKOV: Contribution to the theory of the Brownian movement. The distribution of the phases, velocities and displacements of a free particle. B. DERIAGIN: A new law of friction and gliding. A. MITKEVITCH: The effect of eddy currents on magnetic viscosity. A. SOKOLIK and K. SHCHELKIN: Change of velocity of an explosion wave with pressure. V. SHARONOV and E. KRINOV: An experimental study of the special energy distribution of daylight illumination. N. VOROZHTSOV and V. KOBELEV: Kinetics and mechanism of the catalytic exchange of chlorine for the amino-group. E. BOCHAROVA and B. DOLGOV: Synthesis of the higher alcohols from water gas under pressure. V. KHLOPIN, E. HERLING and E. IOFFE: Emission of helium by minerals and rocks. I. LICHZIER, S. ZHISLIN and Y. STUDITSKIJ: Rôle of collagenic fibres in the process of osteogenesis according to data obtained from grafts transplanted on to the allantois.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, November 18

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—F. A. Bannister: "Symmetry".*

Monday, November 19

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. Kenneth Mason: "The Study of Threatening Glaciers".

IMPERIAL COLLEGE OF SCIENCE.—ROYAL SCHOOL OF MINES, at 5.30.—Prof. P. D. Quensel: "Problems of the Archæan and Iron Ore Formations of Middle Sweden" (succeeding lectures on November 20 and 22).*

ROYAL SOCIETY OF ARTS, at 8.—Dr. Herbert Dingle: "Modern Spectroscopy" (Cantor Lectures. Succeeding lectures on November 26 and December 3).

Tuesday, November 20

ROYAL STATISTICAL SOCIETY, at 5.15—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—Prof. Major Greenwood: "University Education: its Recent History and Function" (Presidential Address).

KING'S COLLEGE, LONDON, at 5.30.—W. Allard: "Design of Channels and Structures—Silt—Losses—Salination".*

Wednesday, November 21

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP), at 7.30.—K. M. Chance: "Urea Plastics" (Joint meeting with the Institute of the Plastics Industry).

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—Miss Lucy E. Cheesman: "An Entomological Expedition to Papua".

Friday, November 23

ROYAL ASTRONOMICAL SOCIETY.—Discussion on "Lightning" to be opened by Dr. B. F. J. Schonland.

ROYAL INSTITUTION, at 9.—Prof. M. Polanyi: "Heavy Water in Chemistry".

Official Publications Received

GREAT BRITAIN AND IRELAND

Eton College Natural History Society. Annual Report, 1933–34. Pp. 43+5 plates. (Eton.) 5*s*.

Universities Bureau of the British Empire. Report of the Executive Council together with the Accounts of the Bureau for the Year 1st August 1933 to 31st July 1934. Pp. 22. (London: Universities Bureau of the British Empire.)

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research for the Year 1933. Pp. vi+67+3 plates. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1934; with Appendices. Pp. 48. (London: H.M. Stationery Office.) 9*d*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1575: Collected Reports on British High Speed Aircraft for the 1931 Schneider Trophy Contest. Pp. iii+100+60 plates. (London: H.M. Stationery Office.) 10*s*. net.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 30th October 1934. Pp. 42. (Newcastle-upon-Tyne.)

University of London: University College. Calendar, Session 1934–1935. Pp. lxxx+12+576+28. (London: Taylor and Francis.)

Prospectus of Harper Adams Agricultural College, Newport, Shropshire. Pp. 28. (Newport.)

The Wellcome Research Institution and the Affiliated Research Laboratories and Museums, founded by Sir Henry Wellcome; and Exhibits at the Chicago Exposition, 1934. Pp. 90. (London: The Wellcome Foundation, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 9: A Study of a Tectibranch Gasteropod Mollusc, *Philine aperta* (L.). By Herbert H. Brown. Pp. 179–210. 4*s*. Vol. 58, Part 1, No. 10: The Life-History and Structure of *Hæmatopota pluvialis*, Linné (Tabanidæ). By Dr. A. E. Cameron. Pp. 211–250. 5*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Society of Edinburgh. Vol. 54, Part 2, No. 16: On a New Species of *Psygmophyllum* from the Upper Carboniferous of Scotland. By Jessie A. R. Wilson. Pp. 188–192+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 9*d*.

Fifth Annual Reports of the National Radium Trust and Radium Commission, 1933–1934. (Cmd. 4711.) Pp. 34. (London: H.M. Stationery Office.) 9*d*. net.

North-East Coast Institution of Engineers and Shipbuilders (Incorporated). Report of the Council, 1933–34. Pp. 16. (Newcastle-upon-Tyne.)

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students. Pp. 414. (London.)

Svenska Ingeniörsallskapet i Storbritannien: The Society of Swedish Engineers in Great Britain, 1924–1934. Pp. 104. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1601 (T. 3496): Accuracy of Performance Measurement. By J. L. Hutchinson and H. Finn. Pp. 5+4 plates. 6*d*. net. No. 1605 (F.M. 150): Abstract—Flow due to a Rotating Disc. By W. G. Cochran. Pp. 1. 2*d*. net. No. 1606 (T. 3303): Abstract—Stresses Induced by Flexure in a Deep Rectangular Beam. By D. B. Smith and R. V. Southwell. Pp. 1. 2*d*. net. No. 1607 (T. 3290): Abstract—A Modification of Oseen's Approximate Equation for the Motion in Two Dimensions of a Viscous Incompressible Fluid. By R. V. Southwell and H. B. Squire. Pp. 1. 2*d*. net. No. 1610 (E.F. 297): Abstract—Analysis of Experimental Observations in Problems of Elastic Stability. By R. V. Southwell. Pp. 1. 2*d*. net. (London: H.M. Stationery Office.)

Battersea Polytechnic. Report of the Principal for the Session 1933–34. Pp. 41. (London: Battersea Polytechnic.)

Department of Scientific and Industrial Research. Report of the Committee on Mechanical Testing of Timber. Pp. vi+41+6 plates. (London: H.M. Stationery Office.) 1*s*. net.

OTHER COUNTRIES

Regenwaarnemingen in Nederlandsch-Indië, 1931. Pp. 113. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions: Vol. 89: 1ère partie, Procès-verbaux (Juin 1934). Pp. 64. (Copenhague: Andr. Fred. Høst et fils.) 3.50 kr.

Bulletins of Indian Industries and Labour. No. 52: Proceedings of the Sixth Industries Conference (Held in Simla on the 9th, 10th and 11th July 1934.) Pp. iii+167. (Delhi: Manager of Publications.) 2.6 rupees; 4*s*.

Anthropological Bulletins from the Zoological Survey of India. Bulletin No. 2: A Comparative Study of the Somatic Affinities of the Maithil and Kanaujia Brahmins of Behar. By Bajra Kumar Chatterjee. Pp. iv+69–216+plates 23–24. (Calcutta: Zoological Survey.) 4 rupees; 6*s*. 9*d*.

Memoirs of the Indian Museum. Vol. 11, No. 2: Studies on Indian Jassidæ (Homoptera). Part 2: Description of the Genotypes of some of the Genera founded by W. L. Distant, with a Revision of the Genus *Moonia* Distant. By Dr. Hem Singh Pruthi. Pp. 69–99+plates 6–7. (Calcutta: Zoological Survey.) 1.10 rupees; 2*s*. 9*d*.

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CONTENTS

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Research and Industry in India

IT is somewhat remarkable, in view of the great interest which is being displayed in Great Britain in Indian political changes, that so little attention has been directed to the developments in industry. Prior to the War, India was regarded mainly as an agricultural country, an exporter of raw materials, vegetable and mineral, whilst with her teeming population she provided a valuable market for manufactured articles. Of large industries there were few—the textile mills in Madras and Bombay, the jute mills in Calcutta and the leather industry in Cawnpore being notable, whilst in Bihar and Orissa the large Tata Iron and Steel Works were in their infancy. As was natural, the exigencies of the War caused a marked industrial expansion, but, in spite of tariff restrictions, many of the new-born industries, frequently possessing a makeshift equipment, were afterwards unable to withstand the competition of Europe, America and more especially of Japan.

Recognition of the unsatisfactory position of Indian industry resulted in 1916 in the appointment of the Indian Industrial Commission of which Sir Thomas Holland was the president ; and one of the outstanding features of the noteworthy report of this Commission was the emphasis laid upon the necessity for scientific research as a basis for future industrial advance. Whilst recommending a general increase in the staffs of the existing scientific services, the Commission indicated the necessity for a comprehensive scheme for chemical research. It is, therefore, remarkable that, although many of the administrative changes recommended in the report have been carried out, no attempt has been made to implement the suggestions for increased scientific research. It is true that in 1919–20 a technical committee under the chairmanship of Prof. J. F. Thorpe elaborated a scheme for an Indian Chemical Service, but the report of this committee was shelved. As was perhaps to be anticipated, when the effects of industrial depression reached India, the first economies were made in the scientific services. The appropriations for the great Forest Research Institute at Dehra Dun, and to the Geological, Botanical and Zoological Services, were drastically reduced and many valuable schemes of research had to be abandoned. It was not apparently realised that the main hope of recovery from the depression lay in more, and not less, research.

In view of this official attitude it is therefore of interest to note that at a recent conference* held under the chairmanship of Sir Frank Noyce, Member of the Viceroy's Council in charge of the Department of Industries and Labour, a proposal was adopted that there should be established at the Alipore Test House, Calcutta, a Research Bureau. This Bureau, which would be under the general supervision of the Chief Controller of Stores, Indian Stores Department, is apparently to be mainly advisory, since one of its principal functions was approved in the following terms: "Assistance to industrialists in India by giving advice and making suggestions as to the directions in which research should be undertaken". At the same time, it is intended to place at Alipore the nucleus of a research staff consisting of two superior officers with six physical and chemical assistants. It is not clear what are to be the functions of this small staff since, as has been already mentioned, the duties of the Central Bureau are to be purely advisory, the intention being that the actual investigations would be carried out in local institutions.

Whilst any attempt to extend in India the facilities for research must be accorded a warm welcome, it is pertinent to inquire in how far the present proposals are likely to be effective. Is a Research Bureau working under the general control of a department concerned essentially with the purchase and testing of Government stores, with the administrative staff of which no one having experience of original research is associated, likely to stimulate research on a broad and fundamental basis or will it tend to encourage minor and *ad hoc* investigations of little value ?

Any consideration of the organisation of research in India necessitates the recognition that industrial conditions in that country are, in many respects, very different from those pertaining elsewhere. The main tendency in countries where industrial conditions are well advanced is to organise in large units with the object of economising in the use of labour. It is becoming more and more doubtful if this programme of rationalisation will, or should, be followed in India. In a country where superabundant labour requires employment, it seems essential that, so far as possible, small scale (cottage) industries should be encouraged. It is obvious that other considerations must apply in the case of certain industries, such as the metallurgical, but there are many others, *inter alia*, the textile industries, the extraction of sugar, of the fixed and essential oils, where economy can be achieved even in small-scale manufacture. Large as are the numbers of workers who find employment in the mills of Bombay and Madras, a far larger number are engaged throughout the country in the handloom industry involving the use of cotton, wool, artificial silk, coir, etc.

It was, therefore, fitting that, at the conference to which reference is made above, much time was devoted to a consideration of the best methods for developing the handloom industries and to the problem of sericultural research. The type of research required for the encouragement of these industries, important as they are, seems to us to be of quite a different order from that research which is so essential if India's great natural resources are to be fully utilised. We do not doubt that the proposed Bureau can, with the assistance of provincial research laboratories, assist these industries, and this is possibly intended to be its primary function. But, even so, the director will have to be something in the nature of a superman if he is to deal adequately with the varied problems which will be referred to him.

It is apparently anticipated that the larger industries will be in a position to provide their own research facilities, and that no direct encouragement or interference by the State is required. It is true that fundamental work of the greatest value has been carried out under the ægis of the Indian Cotton Committee, which has indeed an ambitious programme for future research. Agricultural research is now fostered by the Imperial Council of Agricultural Research, whilst in a somewhat different category, approaching more nearly to the research associations in Great Britain, is the Lac Research Institute at Ranchi financed by the Lac Cess Committee.

Do not these research activities require a connecting link ? Has not the time arrived for the formation in India of a Department of Scientific and Industrial Research on the lines which have proved so successful in Great Britain and other countries ? India is not destitute of men of scientific eminence capable of co-ordinating her research activities and of leading them along fruitful lines, nor is it lacking in laboratories with enthusiastic workers. If the Indian Cotton Committee be excepted, we know of no organisation in India which is planning long-period research on fundamental problems. Only by initiating and

* Bulletins of Indian Industries and Labour. No. 52: Proceedings of the Sixth Industries Conference (held in Simla on the 9th, 10th and 11th July, 1934). Pp. iii+167. (Delhi: Manager of Publications.) 2·6 rupees, 4*s*.

carrying through work of this nature can India hope to utilise to the full her great natural resources. Admittedly, with provincial autonomy there may be administrative difficulties in the way of a Department of Scientific and Industrial Research, but these have been overcome by the Indian Cotton Committee and should not prove insuperable. If science knows no international boundaries, surely there can be no national ones.

The Significant Rôle of the Atom in Cancer Therapy

Radium and Cancer : a Monograph. By Dr. H. S. Souttar. Pp. xiii+387. (London: William Heinemann (Medical Books), Ltd., 1934.) 21*s.* net.

RARE indeed is the physicist who would even attempt to write upon biochemical, pathological and surgical phases of a complex subject in addition to his own subject. But in this book a leading surgeon of the London Hospital writes intelligently of atomic physics along with the surgical uses of radium and cancer with which he has had long first-hand experience. Books of this type, involving a bird's-eye view of a great field, are usually written in these days by the clinical method—in other words, by a group of writers each of whom contributes a chapter from his specialised store of knowledge. Sometimes a fairly successful effort is the result, and sometimes a treatise utterly lacking in unity. But not so with Dr. Souttar. Evidently he has had the spirit of unquenchable inquisitiveness into every possible ramification and mechanism of the subjects of radium and cancer. He has not been content to take radium for granted or to use it on his patients in accordance with some approved formula. With a plea for tolerance from his expert readers he launches into a discussion of the atom, the Bohr theory, the spectroscopy of X-rays and γ-rays, and the whole range of such topics which have any fundamental bearing upon the general subject. These early chapters are clearly and painstakingly written and quite sufficiently accurate within every requirement of a fairly popular account. There is not the slightest earmark that these phases in which the author has been not directly trained are merely abstracted from some physics book and then hastily and thankfully dropped as he enters more familiar territory.

In common with many of the great British men of science, Dr. Souttar has the power of writing excellent English which conveys facts accurately, but at the same time entertains and holds the reader. The present reviewer found this volume almost as difficult to put down, until it was read from cover to cover, as a great novel. The author evidently has sought for helpful and homely analogies to aid his own thinking, and fortunately he has given some of these to the reader : ". . . so that the spectral signatures of the atom of the various elements can be read with the certainty of a banker reading the signature of his oldest client". "The writings of Stevenson and of Chesterton might give us some indication of their characters, but we should scarcely attempt to deduce from them the physical form of the authors". "In the same way, the intensity of the applause aroused by a candidate's election speech may be taken as some indication of the probability that any individual will vote for him". Speaking somewhat slyly of lack of agreement as to details of radium treatment, Dr. Souttar says : "Paris regards as inadequate any period under fourteen days. Stockholm is satisfied that four hours is ample, whilst America, as might perhaps be expected, uses a stop-watch".

In the treatment of the origin of radiation, the author uses rightfully the older Bohr mechanical model of the atom, since the accepted modern wave mechanics version would lead both author and reader beyond a mutually safe depth. But just as Dr. Souttar dismisses these modern concepts, he tries one parting shot at putting into a word picture an atom which is a mathematical equation, and he succeeds quite admirably (page 28) :

> "This conception of energy levels is fundamental in modern atomic theory, far more fundamental indeed than the idea of the revolving electron which serves as a background to the picture. In some ways it is easier to grasp the meaning of the energy level if one conceives of the electron as a continuous band encircling the nucleus and travelling along itself around this centre. If we endow the band with elasticity, we have a simple picture of the energy required to stretch it to the greater circumference of an outer orbit and the atom to a higher energy level, and we can form the mental picture of the output of energy in the form of radiation as it snaps back to the lower level of the inner orbit. Such an idea is in accordance with modern wave theory, and may indeed be a truer picture of the facts than the rotating electron".

Criticisms of the theoretical portion of the monograph arise only as a consequence of necessarily limited treatment. To take a single example, the impression is given from the text and diagrams that there should be $3K\alpha$ and $5K\beta$ X-ray lines (that is, a transition from all three L and all five M levels to fill a vacancy in the K level), whereas actually the selection

principle operates to cut down the possible transitions and the number of characteristic spectrum lines.

The most disappointing feature of the entire monograph is to be found in the treatment of the biochemical phase of the subject—that is, the explanation of chemical, physiological and morphological changes in normal and pathological tissues on irradiation. The author states quite emphatically that essentially nothing is known. Certainly, the information is very scanty, but at least there is a promising beginning. Dr. Souttar is apparently unfamiliar with recent developments, especially in great laboratories in America such as the Mayo Clinic, Rockefeller Institute and the foremost medical schools. Specific radiosensitiveness of cells is mentioned in passing, but not given the emphatic importance assigned by such leaders as Desjardins. Indisputable evidences of changes in *p*H, protein aggregation, viscosity, permeability and osmosis, rate of cell respiration, glycolysis, rate of cell division, etc., are largely overlooked, possibly in an effort to maintain a conservative attitude until further experimental proof is forthcoming.

In the final chapters dealing with the distinctly medical phases of cancer diagnosis and radium therapy, the author is convincingly at home, and everywhere the reader feels the able touch of a surgeon of long experience and successful achievements, deeply and impartially interested as a true man of science, but also glowing modestly with the opportunity to serve suffering mankind. Dr. Souttar is to be congratulated for a notable effort in presenting as a labour of love and as the unified product of a single mind and pen, a book which any intelligent person should be proud to possess.

GEORGE L. CLARK.

Conditioned Reflexes

Vorlesungen über die Arbeit der Grosshirnhemisphären. Von I. P. Pawlow. Autorisierte übersetzung aus dem Russischen von Prof. Dr. G. Volborth. Pp. viii+480. (Leningrad: Medizinischer Staatsverlag d.R.S.F.S.R.; London: Kniga, Ltd., 1932.) 12*s.* 6*d.*

ENGLISH-SPEAKING physiologists have been conscious for the past seven years of the debt which they owe to Prof. Anrep for his admirable translation of the first (1926) Russian edition of this book. The volume before us is a translation into German of the second edition, which was published less than a year after the first. No significant changes have been made in the text, but the bibliography at the end is much more complete. In his preface, the translator states that histological confirmation has now been obtained for the view that destruction of the upper portion of the basilar membrane in the cochlea abolishes responses to low tones while leaving those to high tones unaffected. He also confirms the existence of "conditioned inhibitory stimuli of the second order".

The opportunity which the last few years have afforded of reflecting upon and studying the results of his work since 1900 has done nothing but enhance the prestige of Pavlov as one of the world's greatest physiologists. He first made a reputation by his investigations on the digestive glands and their secretions, and he then made a second reputation by the work now under review. In both series of researches, the ingenuity shown in planning the experiments, the beautiful and difficult technique with which they were carried out, the patience and caution exercised in drawing conclusions, all proclaim the work of a master. But although no one interested in the physiology of the central nervous system can afford to be ignorant of these experiments, there is legitimate room for doubt as to their correct interpretation.

By using the term 'conditioned reflex' for acquired responses dependent upon the integrity of the cerebrum if not upon consciousness, Pavlov implies that the mechanism subserving the response is essentially similar to that of reflex action in the strict sense. He strives to justify this view by reference to the causal relationship between stimulus and response, but when he goes further and mentions "a definite path in the nervous system" as equally characteristic of both responses, our suspicions are at once aroused. There is much evidence that the acquisition of motor habits by a process of learning is a more complex process than the laying down of stereotyped paths in the cerebral cortex, and the same is probably true of the development of 'conditioned reflexes'. To many it would seem advisable to confine the use of so well-established a technical term as reflex to the concept for which Marshall Hall in 1833 introduced it into the vocabulary of science, namely, to describe responses dependent on inherited structure in the nervous system and not on individual experience. Hall considered that "the excited motions which belong to the reflex function are independent of sensation". Unless it can be proved that consciousness is an ineffective by-product of central nervous activity, it is probably wise for us still to exclude from the category of reflex action all phenomena in which mental activities may play an essential part.

There are further difficulties, some of which Denny-Brown has recently emphasised, in identifying psychical secretion of saliva with reflex action. In particular, he finds Pavlov's use of the word 'inhibition' confusing. It is difficult too to find a

parallel in true reflexes for an intense homogeneous stimulus causing no response when a similar stimulus of weaker intensity is effective. It is therefore thought by some to be doubtful whether Pavlov's terminology assists clear thinking. It may be preferable in the present state of knowledge to interpret his findings in psychological terms such as association of ideas, distraction, interest, novelty, attention and memory, and then to look for a physiological basis for these mental processes, rather than to neglect consciousness altogether and fit everything into a hypothetical reflex framework.

Whatever may be the ultimate verdict on these minor points, there can, however, be no doubt about the greatness of Pavlov's achievement. He has at least given us a reliable method for investigating the ability of lower animals to discriminate between different stimuli, a quantitative method of recording the development and strength of acquired associations between stimuli, and a new method of attacking the problems of cerebral localisation. His work will for long provide data of the utmost importance to students of the physiology of the cerebral hemispheres. R. S. C.

Chemical Engineering

Der Chemie-Ingenieur: ein Handbuch der physikalischen Arbeitsmethoden in chemischen und verwandten Industriebetrieben. Herausgegeben von A. Eucken und M. Jakob. Band 1: *Physikalische Arbeitsprozesse des Betriebes.* Teil 3: *Thermisch-mechanische Materialtrennung.* Herausgegeben von A. Eucken. Pp. x+327. 31.50 gold marks. Teil 4: *Elektrische und magnetische Materialtrennung, Materialvereinigung.* Herausgegeben von A. Eucken. Pp. viii+309. 31 gold marks. Band 2: *Physikalische Kontrolle und Regulierung des Betriebes.* Teil 3: *Messung von Zustandsgrössen im Betriebe.* Herausgegeben von Jakob. Pp. xi+275. 28 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.)

ERK and Kirschbaum in Chap. xiv, the first in part 3, vol. 1, consider the separation of materials by evaporation and after discussing the removal of a liquid by boiling and the calculations connected with evaporating problems, describe various types of evaporators and dryers and the factors which govern their performance.

A theoretical treatment of the subject of distillation and rectification, given by Hausen in the next chapter, is followed by descriptions of stills and the methods of determining such quantities as number of plates, etc., for a given set of conditions. In the chapter on crystal formation and growth, in which the usual treatment is adopted, Thiessen and Banthien seem to have confined their references to papers by German scientific workers only, and this fact is noted with regret in two other chapters.

Absorption and flotation processes by Mantner and Bierbrauer are treated in the final chapter. Emphasis is laid on the importance of the surfaces of the particles, and the methods of operation of the various industrial plants described receive due prominence. On p. 264 the reference to the paper by Hollings Pexton and Chaplin, is given as the *Gas Journal* 1929–715. This, as the *Journal* correctly states, was a paper read before the Institution of Chemical Engineers and published afterwards in vol. 7 of its *Transactions*.

Continuing the subject of separation in part 4, vol. 1, Prausnitz and Reitstötter consider electrophoresis, electro-osmosis and electro-dialysis and laboratory work done in connexion therewith before passing to the industrial applications of these principles.

Ladenburg in the next chapter considers the electrical purification of gases, and describes several industrial units engaged on this operation and the methods of working.

In dealing with magnetic separation, Stein discusses very fully such subjects as the formation of magnetic fields, the magnetic properties of materials and their importance in ore dressing. When describing the different types of magnetic separators, reference is made to Mordey's work on separation using alternating current, but his separator is not described in detail. The remainder of this book is devoted to mixing, and Naske opens the subject by considering the mixing of solid materials and the various types of batch and continuous machines designed for this purpose.

Sintering, briquetting and the fusion of materials are considered by Thiessen in the next chapter more from the academic than the practical point of view and greater prominence could well be given to the latter aspect in a work of this kind.

Merkel and Kirschbaum are the authors of the chapter on the mixing of fluids, and this is designed to include such operations as leaching and dissolving as well as the mixing of gases with solids, liquids and other gases, while the final chapter by Thiessen and Eucken is devoted to the formation of plastics, the stability, decomposition and production of dispersions and emulsions.

Ebert, in the first chapter of part 3, vol. 2, after considering the means of measuring pressure, goes on to describe compressors and pumps, and the transmission throughout the works of gases under pressure, while the measurement and recording of temperature and the instruments used for this purpose are carefully considered by Hencky in the following chapter.

Moisture in a gas is of importance in drying operations, so the chapter by Grüss in which the alteration of the moisture content with varying conditions, and the methods used in its determination and regulation, gives valuable information to those testing drying plants or carrying out research on this subject.

In the second section of this book, Krönert describes the various types of calorimeters available for the measurement of the calorific values of solid, liquid and gaseous fuels, and this is followed by two chapters, one by Grüss on the measurement of heat and the other by Burbach on the loss of heat, both of which are of considerable importance to engineers.

All the contributors, in both volumes, have worked to a carefully prepared scheme in which the theoretical aspect of their subject is first emphasised. This is then followed by, in the first volume, descriptions of suitable industrial plants or units and, in the second volume, information on the instruments and regulators to be used. Often, too, hints are given on the methods of working which should yield good results. The first volume, therefore, should appeal more to the designer and user of chemical plant than the second, which is primarily a volume for those engaged in testing or research.

Many engineers, however, and especially those at the commencement of their career, will only become acquainted with this valuable work through lending libraries; this, in view of the excellent way in which the various subjects are treated, is to be regretted.

Short Notices

Traité de zoologie. Par Edmond Perrier. Fascicule 10: *Les mammifères*. Publié par les soins et avec le concours de Prof. Rémy Perrier. Pp. iv+3343–3610. 45 francs. *Index alphabétiques des 10 Fascicules*. Par Prof. Rémy Perrier. Pp. iv+163. 40 francs. (Paris: Masson et Cie, 1932–1933.)

THE volume upon mammals forms the tenth and final fascicule of Perrier's great "Traité de Zoologie". Like its forerunners in the series, it is essentially a morphological and classificatory textbook, and in it the life and habits of the mammals have no place, apart from a short account of limb adaptations.

The greater part of the work (190 pages) consists of comparative accounts of the organic systems of the body. The text is adequate, but the majority of the illustrations have a familiar look, and we must protest against the reappearance of the figure showing the successive annual stages of the growth of the antlers of the red-deer, ending in three stages in which the crown shows an impossible (or at any rate an altogether abnormal) development; nor is it accurate to say that the addition each year of new tines (*andouillers*) "permet de juger exactment de l'âge d'un Cerf".

The remainder of the book (77 pages) gives, in small type, the classification of the Mammalia, down to the characters of families.

The ten volumes, begun by Edmond Perrier and completed by Rémy Perrier, opened with an account of general zoology, and this was followed at intervals by volumes dealing, mainly on morphological and systematic lines, with the groups of the animal world, each of the vertebrate classes having allocated to it a complete volume. A special account of the embryological development of the allantoidian vertebrates was included in the reptile volume. The index consists of two parts, one confined to technical terms, and the other to the names of genera and subgenera, various typographical characters being used to indicate fossil forms, synonyms, illustrations and other details. J. R.

Die Rohstoffe des Tierreichs. Herausgegeben von Ferdinand Pax und Walther Arndt. Lief. 9. Pp. 881–1040. 16.80 gold marks. Lief. 10. Pp. 1041–1216. 17.60 gold marks. Lief. 11. Pp. xxiv +1217–1400. 34 gold marks. (Berlin: Gebrüder Borntraeger, 1932–1933.)

THESE three parts contain the chapter on fibrous materials of animal origin, the greater part of which is devoted to the account of hair, including wool, and bristles obtained from horse, cattle, camel, alpaca and vicuna, sheep, goat, rabbit and pig. The history of these fibres from early times, and the principal localities from which they are now obtained, are briefly set forth. The physical characters and structure of the various types or grades of fibre and the technical processes by which they are spun, woven or otherwise prepared for use, are described, and the commercial designations of the different sorts of yarn and finished products are defined. The testing of fibres for length, fineness and other qualities and the substitutes used for horse hair, wool and bristles are considered. The characters of the hair and bristles of a number of wild mammals and the uses of these fibres are described, and an interesting section on human hair and its applications is added.

Of other fibres considered in this chapter the most important are produced by silk-spinning Lepidoptera, especially the Bombycidæ. The spinning glands are described and their cells, with remarkable branched nuclei, are figured. Details are given of the culture of the silkworms (some 43,000 of which develop from an ounce of eggs), the characters of the silk fibres, the mode of collection, spinning, etc. Among other fibres considered, are spider's threads for the cross-lines of optical instruments, the fibres of the byssus of the bivalve *Pinna nobilis*, and the tendons and ligaments of mammals.

This useful account of fibrous materials, which extends to more than five hundred pages, is well illustrated and includes lists of works for reference.

Outline of Modern Belief: Modern Science, Modern Thought, Religious Thought. Edited by J. W. N. Sullivan and Walter Grierson. (To be completed in about 24 fortnightly Parts.) Part 1. Pp. viii + 64. (London: George Newnes, Ltd., 1934.) 1*s*. each Part.

THIS much-advertised work is clearly printed, copiously illustrated, and makes effortless reading. Some small errors on points of fact are of secondary importance; so also is the quality of the writing, which is not of the high standard to be expected of the editors—though this defect is mitigated by the fact that the original part consists largely of short connecting-links between quotations. What concerns us most is the avowed object of the book. "The editors of this Outline try to fill the rôle of middlemen between the specialists on the one hand, and on the other the plain man who wants to get at the gist of the thing." Following this we read of "modern science—so unlike the dry-as-dust science of old". "The old astronomy told us about the sun, the stars, the planets, their place in the heavens, their movements, revolutions, their nature and peculiarities; the new astronomy goes far beyond that when it speaks about the birth and death of suns and stars, how they are born and why they die; about the mystery of the immense nebulæ from which the stars are born, and about whence came the nebulæ." "The old science of physics dealt with energies—light, heat, electricity, and gravitation, all a little boring to the general reader." "The recent development of Physics has been called 'the most exciting episode in the history of science'." We cannot help noticing that the alleged uninteresting subject-matter is all concerned with trustworthy knowledge, while the interesting things are matters of sheer speculation. The provision of excitement for minds bored by truth is not an undertaking likely to attract many scientific readers.

An Introduction to Plant Biochemistry. By Dr. Catherine C. Steele. Pp. viii + 356. (London: G. Bell and Sons, Ltd., 1934.) 15*s*. net.

THIS book might be taken as affording a measure of how much chemistry the student of botany is expected to know. Somehow, chemistry does not as a rule find favour with botanists; it is perhaps too remote from the other sides of their subject, so that plant physiology is not nearly so developed a field as animal physiology. Indeed it has been largely left to the chemist, whose achievements in unravelling the constitution of the pigments, chlorophyll, anthocyan and carotene, of the alkaloids, sugars and what not else, are well known. But there remains so much to find out in the plant world, there are so many questions unanswered, that every encouragement must be given to any effort to impart and acquire knowledge in this field.

It is from this point of view that we welcome Miss Steele's monograph. It contains a neat and satisfactory summary of the present state of chemical knowledge of the various groups of substances of plant origin. As this information is largely available elsewhere in the up-to-date monographs, in particular those of Dr. Plimmer's series, it has not been difficult for the author to ensure accuracy in its reproduction, and these have obviously been freely used. Superimposed on this framework are allusions to the plants in which the substances occur and there is an index of botanical names.

It should be understood that the material is an elaboration of a series of lectures given to students in biochemistry: the text is interspersed with a number of experiments.

Byzantine Civilisation. By Steven Runciman. Pp. 320. (London: Edward Arnold and Co., 1933.) 16*s*. net.

THIS welcome contribution to Byzantine literature gives an excellent introduction to the historical, social and intellectual atmosphere of the ten centuries during which flourished the eastern portion of the Roman Empire (330–1453). The Imperial constitution and administration, the status of religion and the Church, the organisation of the army, the navy and the diplomatic service, the characteristics of commerce and everyday life, and finally the legacy of Byzantium in the realms of learning, literature and art, are carefully analysed and surveyed in their historical setting.

Many institutions of the Empire can be compared with advantage to present-day ones. The manufacture of arms, for example, was a State monopoly. There was no unemployment. Middlemen were unnecessary, and there were practically no labour troubles. The growing competition of the West, however, hastened on the steady debasement of the coinage, which would appear to be the main cause of the decline and fall of Byzantium. Mr. Runciman gives very brief indications of the scientific and philosophical thought of the Byzantine Empire. What is mentioned, however, shows clearly that the disinterested pursuit of learning was one of the major characteristics of this important civilisation. T. G.

Newnes' Chemistry in Commerce. Advisory Editor: M. D. Curwen. (To be completed in about 32 weekly Parts.) Part 1. Pp. 56. Part 2. Pp. 57–104. (London: George Newnes, Ltd., 1934.) 1*s*. each Part.

THIS work has two main objects, first, to serve as an illustrated 'guide-book' to the chemical works which the articles describe, and secondly to deal with the industries not so much by discussions of the principles on which they depend, as by indicating how such principles are applied in practice.

The excellent illustrations play an important part in the achievement of the first object, particularly where they show 'close-ups' of the more intricate analytical operations; and so far as one can judge from Parts 1 and 2, the second is also being fulfilled. The work is therefore worthy of a wide sale among students, laboratory assistants and junior chemists in industry. If one may venture a criticism it is that occasionally the treatment is uneven; as an example, five out of the seven pages on routine tests for milk at cooling stations are devoted to the Gerber test.

J. G.

The Problem of Ether Drift

By DR. C. V. DRYSDALE, C.B., O.B.E.

IN these days of preoccupation with the wonderful recent advances in what may be called corpuscular physics, and the remarkable achievements of the theory of relativity, the old problem of the existence and properties of a basic medium or ether has receded into the background, and there seems to be a general disposition to disregard an ether as being an unnecessary, or at least an unprovable, hypothesis.

As Sir Oliver Lodge has pointed out in "The Ether of Space", the scientific belief in an ether is essentially of British origin, arising from our 'common-sense' repugnance to the idea of 'action at a distance' without some connecting medium to transmit electrostatic, magnetic and gravitational forces and disturbances. It has dominated the minds of our most illustrious physicists, from Newton to Faraday, Maxwell, Kelvin, Rayleigh and Lodge ; and it has been accepted by a great majority of the most eminent Continental and American physicists, including Einstein.

But since the advent of Planck's quantum theory, the Heisenberg wave electron and Einstein's theory of relativity, we have realised that many phenomena which we used to regard as being unexplainable on a corpuscular hypothesis may be at least partially explained by it. The diffraction phenomena exhibited by an electron stream, when reflected from or transmitted through a thin metallic film, provide a striking example of interference on a corpuscular basis, and it leads to a feeling that all optical phenomena may possibly be ultimately explainable on that basis.

In spite of these successes of the corpuscular theory, however, we have only to turn our minds back to some of the elementary facts and theories to see that the need for an ether remains as cogent as ever. The four fundamental electromagnetic equations of Maxwell are merely statements of elementary experimental facts which any schoolboy can now verify, and they lead by a simple and rigid mathematical demonstration to the conclusion that electromagnetic disturbances are propagated as waves of electric and magnetic forces and displacements which are mutually perpendicular to each other and to the direction of propagation, and with a definite velocity which depends upon two constants respectively analogous to the rigidity and density of an elastic solid and has been shown experimentally to be the same as the velocity of light. The success of Maxwell's theory, with its experimental confirmation by Hertz and further development by Drude, Lorentz and Zeeman, renders it the greatest generalisation in the domain of physics ; and it seems imperatively to call for the existence of an all-pervading medium having a quasi-rigidity and quasi-density.

Moreover, the phenomena of interference, which gave rise to the first demand for an undulatory theory of light, still seem to demand it, in spite of the electron diffraction phenomena. The accuracy with which optical interference effects can be predicted and observed over distances of several metres would involve a constancy of phase relationship between travelling vibrating corpuscles, and therefore identity of their velocities, to within one part in a hundred million, which seems inconceivable on any theory of emission.

Now that we have got down to bed-rock, so to speak, in the experimental demonstration of the existence of the two ultimate particles of opposite electrical charge, the electron and the positron, it would seem that the problem of the existence and properties of the connecting link, the ether, is the greatest outstanding problem in physics. Unless, or until, this problem is solved, the whole fundamentals of science will remain in a confused and unsatisfactory state, and even all our units of measurement will remain irrational and semi-empirical.

It cannot, of course, be claimed that the mere demonstration of the existence of an ether would go far to clear up this confusion, as we are still without any clue to a means of determining the separate values of its two fundamental constants, or to an explanation of its apparently antagonistic properties of elastic resistance to electrical displacements combined with complete freedom from resistance to the motion of discrete electrical charges ; but a definite experimental demonstration of its existence would be a valuable first step, and the only one which seems likely to be convincing would be a demonstration of some influence of motion or 'drift' on optical experiments.

EARLY ATTEMPTS BY 'DRAG' METHODS

Attempts at demonstrating such an effect have been made by numerous scientific workers for more than a century, but it has so far proved the most intractable of all experimental problems. The proof that light travels more slowly in dense transparent media than in air naturally led to the idea that such media would exercise a retarding effect or 'drag' on any motion of the ether relative to the medium, which should enable that motion to be detected by a change in the velocity of light if the motion is in the line of propagation, or by a

deviation if the motion is transverse. As early as 1818, Arago attempted to detect a change in the deviation of an achromatic prism with its orientation, but failed completely. He communicated this failure to Fresnel, who pointed out that it would be accounted for if a moving medium of refractive index n only imparted a fraction $(n^2-1)/n^2$ of its velocity to the light. This suggestion was apparently confirmed in 1851 by the direct experiments of Fizeau with moving water, and by the similar but more refined measurements of Michelson and Morley in 1886.

Meanwhile, Arago's prism experiment had been repeated in a more refined manner by Maxwell in 1867, Airy had attempted to detect any change in astronomical aberration with a water-filled telescope; and Hoek in 1868, and Mascart and Jamin had tried to detect any effect of longitudinal motion by interferometer methods. All these experiments, however, gave the same negative result, and it is easy to show that any attempts at detecting either a longitudinal or a transverse drift by the drag of dense matter must fail if the Fresnel formula is exactly true.

Although comparatively recent, the well-known 'ether model' experiments of Sir Oliver Lodge, which were commenced about 1902, may be mentioned here, as they were an attempt to demonstrate a motion of the ether by the drag of neighbouring moving masses. No such motion could be detected, even when the revolving discs were strongly electrified or magnetised; but it would seem from the theory of Lorentz to be described later that the ether in a dense medium is not entrained by the motion of the medium, and as the connexion between the ions of the medium and the enclosed ether is so much closer than that between the revolving discs and the intervening ether, the negative result scarcely seems surprising.

THE MICHELSON-MORLEY EXPERIMENTS

In 1878, however, Maxwell pointed out in his article on "Ether" in the ninth edition of the "Encyclopædia Britannica", that a relative motion of the ether in the line of propagation should produce a second order change in the time required for light to travel to a distant station and return. For the orbital velocity of the earth, of about 30 km. a second, this would only involve an increase of one part in a hundred million in the time, which Maxwell regarded as beyond the limit of detection. Michelson, however, who was at that time studying in Berlin, resolved on making the attempt, and devised his celebrated interferometer, the first example of which with a 100 cm. base was constructed by Schmidt und Haensch and tried at the Potsdam Observatory in 1881. For the orbital velocity this instrument should have shown a displacement of 0·04 of a fringe, but only 0·004–0·015 of a fringe was observed, and these displacements were regarded as errors of experiment and as giving no evidence of ether drift.

After his appointment as professor of physics at the Case School, Cleveland, in 1881, Michelson collaborated with Prof. E. W. Morley to carry on the investigation on a larger scale; and it has been continued to the present time with successively improved interferometers and technique by Morley and Miller, and since 1905 by Prof. D. C. Miller alone, who has recently published a very complete historical account of the researches*. The first Michelson-Morley interferometer consisted of a concrete base, 150 cm. square and 30 cm. thick, with a wooden float and circular mercury tank so as to allow it to turn freely in azimuth without risk of distortion. Upon this slab the interferometer with a set of additional plane mirrors was mounted so as to reflect each beam backwards and forwards eight times and thus give the equivalent of arms about 1,100 cm. long. This should have shown a displacement of 0·4 of a fringe for the orbital velocity, but when observations were made in a basement laboratory in 1887, the displacements obtained were much smaller, and the experiment is always quoted as having given a null result, although the published conclusion was that the observed drift did not exceed a quarter of the orbital velocity. Miller claims that the observations indicated a definite drift of about 7 km. a second.

The supposed null result of this experiment, however, led Fitzgerald in 1891 to suggest, and Lorentz in 1895 to develop, the famous contraction hypothesis, which should render the detection of a drift as impossible by the Michelson-Morley method as Fresnel's formula made its detection by 'drag' methods. Under the impression that this contraction might vary for different substances, Morley and Miller, at the instigation of Lord Kelvin, determined to repeat the experiment with another material as base, and constructed an interferometer with a wooden cross with arms 430 cm. long, the optical arrangements remaining as before and giving a total length of path for each beam of about 33 metres. Tests with this apparatus in a basement laboratory at Cleveland in 1902–3 again indicated a maximum drift of about 8 km. per second, but the wood was not very satisfactory and it was decided to replace it by a similar cross of steel with a wooden float and annular mercury trough, and to increase the number of mirrors to eight in each arm, thus increasing the total light path of each beam to 64 metres, which should give a displacement of 1·12 fringe for the orbital velocity. After

* *Rev. Mod. Phys.*, July, 1933.

preliminary laboratory trials in 1904, which gave about 7 km. per second for the drift, the apparatus was transferred to the Cleveland Heights and set up in a temporary hut surrounded with glass windows, at an altitude of 285 metres; and trials in October 1905 gave a velocity of 8·7 km./sec. for the drift.

Shortly after this, Prof. Morley retired, but plans had been made for further trials, and in 1921 the interferometer was set up in a hut in the grounds of the Mount Wilson Observatory at an altitude of 1,750 metres, and surrounded with canvas windows. Trials were carried out in April 1921 and indicated a maximum drift of 10 km./sec. Before this result was announced, a careful series of tests was made concerning the possible effects of temperature changes, loading, magnetisation and magnetostriction, and centrifugal and gyrostatic forces. A cross of concrete reinforced with brass was then made up so as to eliminate any possible magnetic effects, and gave similar results in December 1921. As this cross, although heavier, was less rigid than the steel one, the latter was reverted to; and, after further optical improvements had been made at Cleveland, the apparatus was again set up at Mount Wilson in a hut on a new site, with all the refinements previous experience had suggested. Trials made in September 1924 gave the same value of 10 km./sec. for the drift.

(To be continued.)

Science and Food Supplies

A NUMBER of topics came under discussion at the recent symposium on food preservation held by Section I (Physiology) on September 11 during the annual meeting of the British Association at Aberdeen, and a wealth of information and suggestion of biochemical and physiological interest was forthcoming from the authors of the papers. In general, the communications were in fact far too condensed and obviously represented an attempt, which we understand was made at request, to provide a review of the underlying problems of food preservation.

Muscle Proteins

Two of the most interesting problems which are at present to the fore in the study of post-mortem changes in muscle proteins are those of lactic acid formation and of protein denaturation. In the view of Drs. T. Moran, G. A. Reay and E. C. Smith, lactic acid formation is governed by the concentration of salt, the same general relations being obtained whether salt concentration is varied (1) by drying intact muscle, (2) by freezing intact muscle, or (3) by adding salt to suspensions of minced muscle. The salt concentration which determines maximum rate of lactic acid formation is that which determines maximum solubility of the myosin (salt-soluble) fraction of the muscle proteins, and hence it is suggested that an intimate relation must exist between this protein and the enzyme substrate complex responsible for lactic acid production. It is the salt concentration obtained by freezing muscle to equilibrium at $-2°$ to $-3°$ C.

In the study of denaturation, care must be taken that there is nothing in the technique itself which may render the protein insoluble. Toluene as a temporary preservative, for example, must be avoided. Although it has been claimed that so much as 70 per cent of the proteins of muscle are rendered insoluble within twenty-four hours of death, more critical methods show that rigor mortis is not accompanied by appreciable denaturation. The conditions which promote maximum denaturation in subsequent storage have been found to be similar to those which promote maximum solubility; for example, the rate of denaturation in frozen meat or fish is at a maximum at $-2°$ to $-3°$ C.

Prior to this recent work on protein denaturation, it was thought that the only factor influencing 'drip' from thawed-out frozen flesh and loss of quality during cold storage was the rate of freezing, which determined the number, size and position of the ice crystals. It is now clear that protein denaturation plays an important part, and is in addition the principal factor responsible for the 'dryness' and loss of quality of meats and fish preserved by freezing. Guided by this new knowledge, great progress is now being made in the fishing industry. Both quick freezing and subsequent holding at low temperatures are being employed in order to reduce denaturation to the greatest extent possible.

Life-Duration of Fruits

The preservation of fresh fruit presents an entirely different set of problems. In their discussion of these problems, Drs. F. Kidd and C. West stated that the fundamental issue is the question of life-duration and of the factors determining it. Analysis has shown that race, nutrition and environment are the principal determinants: and further, that the respiratory activity per cell unit of the organism appears to be an integrated expression of the influence of these factors upon life-duration. The higher the pitch of activity, the shorter the life and vice versa. Death of the organisms after separation from the tree is not, however, simply due to exhaustion of sugar reserves. "If we may take a mechanical analogy,

the ageing and death of the fruit seems to be related rather to the wearing out of the machine by use than to the failure of its fuel reserves."

An interesting experiment described was one in which the life-duration of apples gathered at different stages of their growth from June onwards was determined. Maximum life-duration was exhibited by young fruits of about walnut size. Cell division had ceased in these fruits and the major enlargement by increase in cell size and storage of sugars had not taken place. It is at this stage that they exhibit minimum respiratory activity per cell unit.

Respiratory activity after gathering is subject to control by varying the temperature and the composition of the atmosphere. In either case, reciprocal effects on life-duration are obtained. The effects of oxygen and carbon dioxide concentration are new, and while still subject to analysis, have already been widely applied industrially in the fruit industry.

COMPOSITION OF FISH FATS

A considerable amount of new ground has been broken recently in regard to the composition and physiology of fish fats. The position was reviewed, especially in the light of his own work at the Torry Research Station, by Dr. J. A. Lovern. As a class, fish fats are characterised by a greater number of individual fatty acids than are found in land animals: further, there are noticeable differences in the fats laid down by fresh-water and marine species. It appears that, in general, the peculiarities in the composition of fish fats can be traced back through the dietary chain from large carnivorous fishes to the vegetable feeding copepods. Curiously, however, in the case of the young salmon, its fat changes from the fresh-water type to the marine type while the fish is still in fresh water.

In laying down their fat reserves, there is, in the case of many fishes possessing more than one fat depot, a marked selectivity as between these depots. This selection appears to be governed by molecular size. In the mobilisation of fats for transference to the gonads, there is no evidence of selection as between depots, nor can evidence be obtained that the liver is active in desaturating fats as a preliminary to their oxidation, for in many cases the liver fats are found to be more saturated than the depot fats.

F. K.

The Mendeléeff Centenary and Scientific Progress in the U.S.S.R.

AN international congress in honour of the hundredth anniversary of Mendeléeff's birth was held last September in Leningrad with a splendour appropriate to his importance as the greatest Russian man of science. The official list mentioned 'delegates' from many countries. As, however, the Russian Academy of Science had preferred to send personal invitations to scientific workers abroad instead of requesting societies and associations to send their representatives, we should more properly describe those who took part in the congress as guests. There were 26 foreign participators and about 300 official Russian delegates, besides some 1,400 unofficial Russians, who attended the lectures.

In planning the congress, the Russian Government set out not only to pay tribute to Mendeléeff's memory, but also to give the members an idea of the present-day position of Russian science and industry, so far as was possible within a fortnight. Therefore the lectures more or less closely connected with Mendeléeff and his work took place in the first part of the session. In connexion with it there followed inspections of scientific institutes in Leningrad, Moscow and Kharkov, and a visit to the industrial works at Dnjeproges.

The congress began on September 10 with a ceremonial inauguration in the former Taurian Palace in Leningrad, in the hall in which the Duma used to meet. It was specially impressive that welcome to those taking part was uttered not only by the president of the Academy and some high Soviet officials, but that at the end of the first meeting the platform was taken by twenty or thirty workmen in their working-clothes, whose speaker bid the congress welcome in the name of the engineers and chemical workers of Leningrad, and expressed their appreciation of Mendeléeff's life work for the industrial development of Russia. In consequence of the manner in which the invitations had been sent out, there were no addresses from foreign societies. Only the Royal Society of London, which had specially close relations with Mendeléeff, sent greetings by one of its fellows, Prof. J. W. McBain (Stanford University).

The first lectures were devoted to Mendeléeff's memory. In consideration of foreign delegates, some of the Russians spoke in French, or at least repeated from time to time the essential gist in a few sentences in French. Nevertheless, foreign visitors were mostly dependent on the printed synopses or the kindly translations of colleagues for their understanding of the Russian contributors, and therefore lost many details. Prof. Bajkov gave a description of Mendeléeff's scientific work. Prof. Ivanov dealt with Mendeléeff's

activities as president of the Institute of Weights and Measures.

Only on the second day did foreign representatives speak. After a lecture by Prof. Roždestvenskij on spectra and their relation to the Periodic System, Prof. Paneth (London) dealt with Mendeléeff's views on the chemical elements as the ultimate basis of the science of chemistry, pointing out that he rejected to the end of his life the idea of their compound nature. Dr. Rumer spoke on quantum chemistry, Prof. Boldyrev on crystal structure and ionic radii; Prof. Lise Meitner (Berlin) lectured on atomic nuclei and the periodic system; Prof. W. Biltz (Hannover) gave a summary of his extensive researches on the volumes of chemical compounds in the solid state. On the third and the fourth days, lectures were given by the following: Prof. Fersmann, on the periodic system in geo-chemistry; Profs. Černiajev and Grünberg, on complex salts; Prof. Walden (Rostock), on electrolytes and solvents; Profs. Kurnakow and Stepanov, on Mendeléeff's theory of solutions; Prof. Zelinsky, on his contact theory; and Prof. Nametkin on his work on petroleum.

Opportunities to visit scientific institutions in Leningrad were afforded to delegates even before the official opening of the commemoration, during intervals between meetings, and on the fifth and sixth days of the congress. Even those acquainted with the literature concerning the intensive scientific work of their Russian colleagues were impressed by the extent of the investigations being carried on in the various institutes through which they were conducted—as, for example, the Radium Institute (directed by Profs. Vernadsky and Chlopin), the Institute of Chemical Physics (Prof. Semenoff) or the Institute of Technical Physics (Prof. Joffe). It would be very difficult to name any important modern problem in the sphere of physics or chemistry which is not being attacked by Russian scientific workers in friendly rivalry with their colleagues in Western countries; while the financial resources which are at their disposal for scientific purposes are in certain cases even better. The visitors' attention was directed with special pride to the number of pieces of apparatus made in Russia itself; it may be mentioned, for example, that complicated glass apparatus has been made almost exclusively of glass from Russian factories and manipulated by Russian glassblowers; and that the giant electromagnet on the ground floor of the Radium Institute, and the neighbouring high-tension apparatus (for the acceleration of charged particles by E. O. Lawrence's method) owe their construction and erection to Russian material and Russian electricians.

After the congress had lasted six days in Leningrad, the majority of those taking part accepted the Russian Government's invitation to visit Moscow, where the Karpov Institute formed a special centre of attraction. This Institute, called after its founder, is now housed in two large buildings, and the visitors were greatly interested to see the work on physical, colloidal and inorganic chemistry in the departments of Profs. Frumkin, A. Rabinowitsch, Kasarnowsky and Sirkin, and to talk to these workers. It was a happy thought of the directors of the congress to link with the inspection of several institutes informal lectures and colloquiums. In the Radium and the Chemical-Physics Institutes in Leningrad, in the Karpov Institute and in the "Scientists' House" in Moscow, several of those taking part in the congress made short reports on topical physico-chemical subjects, which were then thrown open to discussion. Besides those lecturers mentioned in the official programme, other members of the congress heard in this way were Profs. Hahn (Berlin), Hönigschmid (Munich), Stranski (Sofia), Centnerszwer (Warsaw), Palmaer (Stockholm), Brønsted (Copenhagen), Heyrovsky (Prague), Mark (Vienna) and Dr. and Mrs. Noddack (Berlin).

A somewhat reduced party then continued the journey to Kharkov and Dnjeproges. The Physical-Technical Institute in Kharkov, considerably smaller than the Karpov Institute, is directed by Prof. Leipunsky, and devotes its activities principally to low-temperature experiments and to atomic disruption. Indeed, this very modern sphere of research is already being tackled in several Russian institutes. We mentioned above that the Leningrad Radium Institute intends to use Lawrence's method, the Technical Physics Institute has already at work a high-frequency installation similar to that of Cockcroft and Walton at Cambridge, and in Kharkov Van De Graaff's method of electrostatic charging is being used. The visit to Kharkov was also of great interest for members of the congress because the incredibly intensive building activity, which in Leningrad and especially in Moscow (for example, the construction of an underground railway) often still impedes traffic and causes much dust, has already produced imposing results in Kharkov. The visit to the "House of Industry", an enormous block recalling sights of American towns, and the view from its fourteen story roof over the neighbouring quite recently developed town-quarter, with its fine offices and modern workmen's houses, will certainly be unforgettable for all who took part.

The most southerly point of the journey was reached in Dnjeproges. (Until recently the establishment was called Dnjepostroj, but as the last

syllable of this word designates a building in course of erection, the official name is now "Dnjeproges", a contraction for "Public Electricity Station on the Dnjepr".) Here is one of the greatest industrial installations in Europe; but the curved dam, almost 800 m. broad and 50 m. high, serves another purpose too. Above this point there were rapids in the Dnjepr which rendered shipping impossible, and many earlier projects for the regulation of the river were abandoned as impracticable. To-day the dam, in connexion with a system of locks, permits navigation from the Black Sea to Smolensk, a distance of nearly 1,400 miles; this is especially important for the transport upstream of benzine, and downwards of wood, apatite and flax.

The utilisation of the falls provides the Ukraine with cheap power. The installation is planned for nine generators each of 90,000 h.p.; six are already running. Here also the visitor is informed that the last two were not manufactured by the G.E.C. (Schenectady) but were built in Russia, apparently to exactly the same plan. The electrical power generated here, to amount to 600,000 kw. when the plant is in full working order, will be largely utilised in the neighbouring complex of industrial works (called Combine), which has sprung up in the course of recent years. (The population of Dnjeproges has already increased from 2,000 inhabitants in 1927 to 130,000.) The inspection of the works was especially interesting because here an attempt is being made to run parts of the plant as soon as possible without waiting for the completion of closely associated factories. Two blast furnaces of the largest size (each of 900 tons capacity), numerous electric furnaces for the manufacture of tool steel and iron alloys, and a bauxite plant for the electrolytic production of aluminium with a yearly production of 20,000 tons, are already at work. A sign of this uneven development in which the works find themselves at present is the mighty gas flame visible from afar at night, which burns from the coking plant; the utilisation of the gases and their by-products is of course under consideration, but operations had to be started before the works were complete.

Owing to the modern close relationship between chemistry and agriculture, it is easily understandable that the congress officials had also fitted into their programme an inspection of a collective farm (Kolkhoz) near Kharkov. Those present were naturally glad not only of an opportunity of seeing something of the typical Ukrainian landscape but also a model establishment. Nevertheless, they were aware that in this case they were not specialists and that the existence of a few particularly well-conducted community holdings gives no key to the results of general agricultural production—quite different from the inspection of Dnjeproges, where the functioning of this one powerful industrial centre naturally already means much for a great part of the U.S.S.R.

After returning to Kharkov, the members of the congress separated, all undoubtedly conscious of having experienced a very interesting time. The Russian Government had arranged that the delegates, so far as scientific sessions and visits permitted, should also have opportunities of visiting museums; congress membership cards procured free entry everywhere, even at times when the museums were officially closed. The Russian public were informed in detailed newspaper accounts of the course of the congress; at the same time were published papers on the history of the Periodic System (compiled by Prof. M. Bloch), a new edition of Mendeléeff's textbook, and the first volumes of a collected edition of his writings; and even special postage stamps, really artistically valuable, were printed, showing the portrait of Mendeléeff before a table of the Periodic System. In short, the Government manifested in every way its desire to give to the congress the mark of a great occasion, and thereby to express its respect for Mendeléeff the scholar and for science. In this sense it certainly intended the magnificent banquet given to nearly four hundred delegates in the Peterhof, the former country seat of the Czars near Leningrad, the decorated rooms, gilt statues and coloured fountains of which shone with a splendour which could scarcely have been greater in honour of any crowned head before the War.

Reverence for science—that was the special note of the congress. Among the Russian and foreign delegates were presumably supporters of the most varied political parties; under the unifying bonds of science they found themselves in complete harmony. The representatives of all countries emphasised in their speeches again and again the internationality of science—which would almost seem a commonplace if in recent years there had not occasionally been other manifestations. None the less, the memory of a great man is more honoured in the furtherance of his efforts than in speeches or commemorations. Everyone knows the kind of jubilee in which the name of the celebrity is mentioned in numberless eulogies but where very little of his spirit is to be felt. The most satisfactory thing about the Mendeléeff centenary celebrations in the U.S.S.R. was the impression that the powers that be are honouring Mendeléeff's legacy not only in words but also in deeds, through encouragement of science itself and of a technology and industries founded on scientific lines.

F. A. P.

Obituary

PROF. J. G. GRAY

ENGINEERS and naval architects, and medical men and women, scattered over the world, who were students at the University of Glasgow at any time in the past thirty years, will find it difficult to realise that the energetic, youthful and cheery personality of Prof. James Gordon Gray is gone from the classrooms and laboratories in which his inspiration and enthusiasm for modern applied science were available in such abundance. He lectured to two classes on November 5, and collapsed suddenly, at home, on the next afternoon.

Prof. Gray was born at Glasgow in 1876; he was the second son of the late Prof. Andrew Gray, who succeeded Lord Kelvin in 1899 to the chair of natural philosophy at the University of Glasgow. A graduate in electrical engineering, Prof. Gray joined his father's staff in 1904, and gave him much assistance in the planning of the present Natural Philosophy Institute, opened by their Majesties the King and Queen in 1907. For several years he was senior assistant in natural philosophy, and lecturer in medical physics, and his unique experience in engineering and in medical physics led in 1920 to his appointment to the new chair of applied physics, founded through the generosity of Sir John Traill Cargill, Bt., to take over the teaching of physics to all students of applied science.

At the time of his appointment, Prof. Gray was already well known for his scientific work. In his younger days he had carried out much research work on the magnetic properties of iron alloys and other alloys at liquid air temperatures and at temperatures near the Curie points of the alloys. Gradually he developed a special aptitude for designing gyroscopic apparatus to illustrate results obtained by Lord Kelvin and Prof. Andrew Gray, and finally he gave all his spare time to the theory and practice of gyroscopes. He was the inventor of motor gyroscopes and accessories, and of a large number of gyroscopic experiments that were of great educational value to his students, and of interest to thousands of others to whom he lectured all over Great Britain. His aim, frequently expressed, was to attain, by means of gyroscopes, real stability where only quasi-stability had been known before; and in this aim he was successful. During the War he co-operated with the Government in the development of appliances for use in aerial navigation and national defence, and spent much time in the air trying out the gear he had designed. Angular momentum and the laws it obeys were very real to him, and he had an uncanny faculty for designing elaborate gyroscopic devices that functioned correctly on first trial. Stabilisers for aeroplanes and for ships, artificial horizons, automatic steering devices, apparatus for blind flying, were all developed by him. He was the pioneer inventor of the magnetic inductor compass used by Col. Lindbergh in his Atlantic flight.

Prof. Gray was a member of the Institution of Electrical Engineers, and a fellow of the Royal Society of Edinburgh. He was joint author, with his father, of "A Treatise on Dynamics", revised by him three years ago; and he had published numerous scientific papers. His last work, entitled "Gyroscopic Pendulums", was completed a short time ago, and is now in the press; it consists of the Thomas Gray lectures, delivered by him this year before the Royal Society of Arts.

Prof. Gray's sudden death leaves a serious gap in the ranks of scientific workers, especially among those engaged on gyroscopic devices. He had a delightful personality, was genial in company, sympathetic to all in bereavement, and was loved by colleagues, staff and students. His students always referred to him affectionately, for his happy spirit quickly formed a bond of friendship between him and his audience, whether that audience were one of his own large university classes, or the members of one of the many scientific societies to which he lectured.

R. C. G.

DR. S. K. MUKERJI

WE regret to announce that Dr. Sushil Kurmar Mukerji, reader in botany in the University of Lucknow, and honorary secretary of the Indian Botanical Society, died on August 5.

We are indebted to an obituary by Dr. B. Sahni in *Current Science* of September for the following particulars of Dr. Mukerji's career. Born in 1896 at Nawgong in Central India, S. K. Mukerji was educated at Allahabad, graduated bachelor from Muir College, and master from Canning College, Lucknow. He was later appointed to the staff of the last-mentioned College, and on the inauguration of the University of Lucknow, he became demonstrator in botany, then lecturer, and, in 1927, reader.

Dr. Mukerji came into contact with many English botanists when he was preparing a thesis on the ecology of dog's mercury (*Mercurialis perennis*) for the degree of D.Sc. in London between 1925 and 1927. Prof. F. W. Oliver and Prof. E. J. Salisbury introduced him to a study of the soil relations of plants. He was elected a fellow of the Linnean Society, and became a member of the Sectional Committee for Botany and Forestry of the British Association at its Leeds meeting.

Since 1927, Dr. Mukerji has been studying the flora of the country round Lucknow, and also had a wide sphere of more general interests connected with the University there. At the time of his death, he was working on the fossil plants collected by the Yale University expedition to the Karakorum Mountains.

WE regret to announce the following deaths:

Prof. James Mark Baldwin, author of the "Dictionary of Philosophy and Psychology" and other works, on November 8, aged seventy-three years.

Prof. Karl von Linde, known for his work on refrigeration and the liquefaction of gases, on November 17, aged ninety-two years.

News and Views

Prof. H. C. Urey

It is announced that the Nobel Prize for chemistry for 1934 has been awarded to Prof. H. C. Urey, of Columbia University, New York. Prof. Urey was responsible for the search for a heavier isotope of hydrogen, and for its detection by means of its spectrum. This heavier isotope, of mass about double that of the ordinary hydrogen atom, has since been obtained in the form of its oxide, 'heavy water', in a pure condition, and several other compounds, for example, an ammonia in which the three hydrogen atoms are replaced by heavy hydrogen. The new element has been called deuterium, and has been the subject of intensive investigation during the last two years. Unlike the isotopes of heavier elements, its properties differ in a marked and interesting way from those of ordinary hydrogen, and apart from its intrinsic interest, deuterium has already been put to several uses as an implement of research in various fields of chemistry and physics. Just as the discovery of the element radium by Mme. Curie, a chemist, opened out a new physics, so it may be expected that the discovery of deuterium by the present Nobel laureate in chemistry will have important consequences for physics as well as chemistry.

Robert A. C. Godwin-Austen (1808–84)

NOVEMBER 25 is the fiftieth anniversary of the death of Robert Godwin-Austen (whose name was originally Austen, afterwards changed to Godwin-Austen). Godwin-Austen was prominent in the ranks of the early British geologists, and a notable and constant contributor to geological science. He was born in 1808, and died at Shalford House, Guildford, at the age of seventy-six years. Austen's interest in geology had been stimulated whilst at the University of Oxford, where he had been a pupil of Buckland. He joined the Geological Society of London in 1830 (the year of publication of Lyell's "Principles of Geology"), when Sedgwick was its president, and read his first geological paper at Somerset House entitled, "An Account of the Raised Beach, near Hope's Nose, in Devonshire, and upon recent Disturbances in that Neighbourhood" on November 19, 1834. Austen was then residing at Ogwell House, near Newton Abbot, and this paper was the forerunner of pioneer field work in Devonshire, and a close association with De La Beche. The latter recorded that in the district extending from Dartmouth to Chudleigh he was principally indebted, as regards this part of the Geological Survey Map of Devon, to Austen; Phillips mentioned the "splendid series of fossils . . . fruit of the personal exertions of Mr. Austen". Further observations on south-east Devonshire were embodied in a classic paper covering the years 1834–40. Certain inferences respecting the Coal Measures were detailed in the paper "On the possible Extension of the Coal-measures beneath the south-eastern part of England" (1856). Godwin-Austen was awarded the Wollaston medal of the Geological Society in 1862, and referred to as "pre-eminently the physical geographer of bygone periods". In later years he resided at Shalford, Guildford, and there were consequent changes in his geological studies in a new area. Godwin-Austen was elected a fellow of the Royal Society in 1849.

David Douglas, 1798–1834

A BOTANICAL collector and explorer in many British territories, David Douglas, the Scottish naturalist, was born at Scone, near Perth, in 1798, and of humble parentage. To his zealous efforts are due the introduction into England from time to time of numbers of new trees, shrubs, and herbaceous plants, comprising hundreds of species. Much valuable information, in addition, was derived from him respecting the characteristics of the lands (some hitherto unexplored) that he visited. Douglas in early life began a seven years' gardening apprenticeship with the Earl of Mansfield, at Scone. On its completion, he worked at the Botanic Garden, Glasgow, where his abilities attracted the notice of Dr. W. J. Hooker, then professor of botany in the University of Glasgow, who took him as companion in journeys through the Western Highlands. In 1823, Hooker recommended Douglas to the Royal Horticultural Society of London, for botanical exploration work in North America, and under the Society's auspices he pursued this mission until the year 1827. Various and successive travels followed down to 1833. From California he penetrated northward into Russian America (Alaska) in one of these. Early in 1834, Douglas was at San Francisco and thence he embarked for the Sandwich Islands; in May of that year, he wrote home to Capt. Sabine giving accounts of journeys to the summits of the mountains and volcanoes. In November 1834 news reached England that on July 12, previously, Douglas had lost his life in an unfrequented track through the attack of a bullock. A monument exists at Honolulu recalling the fatality and Douglas's services to science.

Long Heads and Broad Heads in Germany

It has always been a disconcerting fact to those who uphold the Nordic origin of German nationality that the predominant shape of head in the population is broad and flat, rather than of the long narrow Nordic form demanded by the favoured theory of racial origin. Various attempts have been made to explain away the anomaly; while some critics have not hesitated to say that the official figures of head measurements of the population were 'edited' before publication to eliminate the undue proportion of broad heads. Certainly Prof. F. G. Parsons, who measured German prisoners of war, found that they showed a greater breadth by several points than the figures accepted by German anthropologists as representing the German type of head. Some who admit the discrepancy invoke the Mendelian theory of

inheritance and regard the broad head as a dominant masking the long-headed Nordic element. A new theory has been put forward, or rather an old theory revived, in Germany, making the shape of the head fortuitous and eliminating its significance for the Nordic theory. Prof. Kruse of Leipzig, according to the *Times* of November 19, argues that the shape of the head depends upon whether babies are laid on soft or hard pillows. On soft pillows they lie on their backs and hence, he maintains, although originally long-headed, come to have broad heads as they grow. A broad head, therefore, is no disproof of Nordic ancestry. In the middle of the sixteenth century, Vesalius noted the difference between the rounded head of the Turk and the broad flat head of the German. The former he explained as due to the swathing of the head and the action of the midwife, and attributed the latter to the fact that German babies slept on their backs in their cradles, while the Belgians, sleeping on their sides, had longer heads. It is interesting to note that in Dürer's representations of German peasants at about the same date, the broad flat head is very marked.

Academic Assistance Council

LORD RUTHERFORD's progress report of the Academic Assistance Council in a letter to the *Times* of November 16 is a statement in which the whole academic body of Great Britain may take legitimate pride. The Council, indeed, has not accomplished everything it would have wished; but its efforts nevertheless have effected much. Of the German scholars and men of science displaced since April 1933, Lord Rutherford says that 200 have found permanent places and 325 have been provided with temporary facilities for continuing their research outside Germany. In other words "at least two thirds of the whole number who were justified in looking to continue their scientific work have been assisted to remain in the academic world". Emergency grants have been given when needed and are still being given to 71 scholars and men of science while they are seeking posts. This is a remarkable achievement for an undertaking which was initiated in a period in which the whole world, and more especially the two countries which might be relied upon to respond generously to such an appeal, namely, Great Britain and the United States, were in a state of economic depression without a parallel. The need for effort, however, still remains, for the funds available for meeting present commitments will be exhausted in July 1935. Further, while Lord Rutherford is in a position to state that the work of the Council has now attained a basis of international co-operation, this announcement, unfortunately, coincides with a report of the financial collapse of national committees on the Continent.

LORD RUTHERFORD goes on to outline a further objective. The size and nature of the problem with which the Council has had to deal hitherto is now definitely known; and it is proposed to add to the functions of the Council the formation of a trust for creating a number of research fellowships which will be available for scholars and men of science of special distinction, who are debarred from carrying on their work in virtue of their race, religion or political opinions. These fellowships will be awarded irrespective of nationality. It will be remembered that, although the work of the Academic Assistance Council has necessarily been directed to the alleviation of the difficulties of those who have suffered through the political situation in Germany, the purpose of those by whom the Council was founded is to assist any, of whatever nationality, who might be dispossessed on such grounds. The same principle will be applied in the award of the proposed research fellowships. Already Lord Rutherford has been able to announce the prospect of a contribution from America which will provide for 36 research fellowships tenable for a period of three years in any of the universities within the British dominions. This generous offer will no doubt stimulate other contributions. Should the proposal of the Council come to full fruition on a pan-national basis, it will confer upon it a unique position as a permanent international rallying point for the defence of academic freedom—a consummation eminently to be desired in the present trend of world conditions.

University Education

IN his inaugural address to the Royal Statistical Society on November 20, the president, Prof. Major Greenwood, discussed the "Recent History and Function of University Education". Speaking of the statistical changes in the proportion of males in England and Wales who have entered upon a university course since 1801, Prof. Greenwood estimated that at the beginning of the nineteenth century, when Oxford and Cambridge were the only English universities, about one-half per cent of males had a university education, a very slightly larger proportion at the middle of the nineteenth century and now about 2 per cent. In Germany, before the Nazi regime, it was estimated that not more than 3 per cent of university students came from working class families. It is unlikely that the proportion is more than 10 per cent in England and Wales. An author writing in the first volume of the Society's *Journal* estimated that the universities of Great Britain had a total revenue in 1831 of £800,000 per annum; in 1931–32 their total income was £5,874,778, of which more than £2,000,000 came from Parliamentary grants.

THE renaissance of English university education which began rather more than eighty years ago led to a discussion of the functions of a university to which Cardinal Newman, Mark Pattison and Walter Bagehot all contributed; their views, however different the expressions, were essentially similar, namely, that higher education in its highest and best sense implied segregation; "a university should be situated," said Pattison, "like the poet's garden, 'Not wholly in the busy world, nor quite beyond it'." Prof. Valentine has recently shown that in universities now, even among scholarship entrants, a sensible proportion (in the modern provincial universities) fail

to reach honours standard. Mr. Abraham Flexner also has recently criticised the intellectual standards of British and American universities. The question accordingly arises whether the standard of intellectual selection should be maintained or even raised, or whether a wider conception of the function of a university should be entertained. Prof. Greenwood stressed the new factor of increasing leisure, and referred to the serious dangers to political freedom arising from an uneducated democracy to which the Bishop of Winchester has recently directed attention. The value of education from the hedonistic point of view has been insufficiently emphasised; while the ideal of Newman and Pattison cannot be realised in a great city, an even nobler ideal might be entertained. "In a great city what one loses in intimacy may be compensated by a gain of continuity. I think of the *universitas* of a *studium generale* in London as not restricted to the enrolled teachers and matriculated students, but as comprising the *universitas* of men and women to whom study and research can bring happiness and recreation."

The Electron in Industry

A RESEARCH and Development Lecture, arranged by the Royal Institution and the British Science Guild, was given by Mr. Clifford C. Paterson, director of the Research Laboratories of the General Electric Company, Wembley, on November 21, at the Royal Institution. After the work of J. J. Thomson, electricity could be thought of in terms of the individual electron, its habits and affinities. One of the two main reasons for the practical usefulness of electricity is its ease of control. The other is its transportability. It is in the direction of the control of electricity that the free electron has of late given the engineer new and extraordinary powers. The secret of the revolution is that electricity can now be freed from conductors. A stream of free electrons, whether in a vacuum or a gas, can be manipulated with such facility that the electricity can be increased or decreased at the rate of millions of times a second, or alternatively as slowly as desired, and no limit is set to the amount of energy which can be so controlled. It was the object of the first part of the lecture to explain and to demonstrate why these extremely rapid actions of the electrons are wanted. So much of what the eye sees and the ear hears consists, if analysed, of extremely rapid happenings. The eye and the ear are unconscious of these high-speed fluctuations and vibrations although sensitive to them. In order that these very rapid oscillations and variations may be faithfully reproduced and transmitted it is necessary to make exact electrical copies of them. This is done by suitably controlling a stream of free electrons.

THE two principal electron liberator devices discussed by Mr. Paterson were the thermionic valve and the photoelectric cell. To illustrate the potentialities of these, he demonstrated experimentally how the mechanical movements of a needle on a gramophone record can be converted into electrical pulses; then impressed on to the current in a luminous discharge lamp and changed to light pulses; the beam of light carrying exactly equivalent modulations can be passed across a room and reconverted by a photocell into electrical pulses. These again can be amplified and, by a loud speaker, reconverted into sound waves in the air. The free electron is also being used in new ways in the art of electric lighting. The many coloured luminous discharge tubes used for display purposes in the streets have led the way to more brilliant and more efficient light sources. Some of these give much more light for the electricity consumed than existing filament lamps. The effects are the result of high-speed encounters between free electrons and the gas atoms in the tubes, at speeds up to six million miles an hour. Electricity which is liberated from the metals, which in the older engineering restrained it, is having industrial applications of the highest importance.

Fuel Research

FUEL research was discussed by Sir Harry McGowan, who succeeds Sir William Larke as president of the Institute of Fuel, in his presidential address on November 12. Experience, he said, has taught him the vital connexion between research of all varieties and commercial and financial prosperity, whether it is applied to the improvement of present methods of working an existing process, to the production of an entirely new commodity as an alternative or substitute for one now in use, to the safety of those who labour in industry, or to an examination of the demands of the consumer. Research in one industry cannot ignore the results of research in others, for all economic facts are intimately connected, and a change in any part of the economic structure inevitably induces changes in other parts. Our national fuel asset is coal, and our original industrial monopoly was based upon the introduction of steam power and the development of railways. Development, though world-wide, has not, however, been uniform; it has a ragged front, and new knowledge is continually changing relative national positions. Sir Harry McGowan referred to the domestic use of raw coal, which is still preferred to smokeless semi-coke by the ladies who command the household and value a cheerful flame above the more economical and healthy use of coal. More propaganda and technical research are needed to bring home to the public what coal can do in the home. Sir Harry mentioned that whole suburbs of cities in France are heated by a high-pressure hot water ring main based on coal, and that an astonishing economy in fuel has been achieved. On the other hand, the industrial users of coal base their demands on specific requirements as to effective heat value. Sorting and grading are usual, and much better coal than was previously thought obtainable has been brought on the market.

POWDERED coal, continued Sir Harry McGowan in his presidential address, is comparatively a newcomer into the power field. It speedily affords a high temperature, permitting rapid adjustment to varying load (such as a sudden demand for electricity

on a winter's day), and thus provides a bulwark to the coal industry against the further invasion of oil. Colloidal fuel, a fine suspension of coal in oil, has not achieved the success which it appears to deserve. It is important for us to discover whether this lack of success is inherent, or whether it is due to some minor technical defect which can be overcome by research. A Diesel engine using powdered fuel might easily go a long way towards restoring the disproportionate consumption of oil as against coal. As regards coke, Sir Harry McGowan raised the question whether the amount of money spent on research on coke is proportionate to the tremendous turnover in the industry. He sees no reason why gas and electricity should not progress side by side as friendly rivals in a field of enterprise which will lead to an enormous net increase in the use of coal. Unlike electricity, gas is storable, and a national gas grid might fulfil many useful functions without injuring the interests of electricity. The difficulties are legal and financial, rather than technical. Sir Harry referred also to the large-scale research on the production of oil from coal; the subject has proved to be so big that nothing less than international action has been sufficient for full development. Turning to means for promoting research, he suggested that the fuel industry might proceed by prize or by levy. He asked, for example, what would happen if a prize of £100,000 were offered for a ship to be driven alternately by coal and oil, whichever is cheap in a given port. On the other hand, the coal industry is well acquainted with the levy principle; a farthing a ton would provide £250,000 a year, which could be entrusted to a Fuel Development Committee for allocation between technical research, market research and propaganda.

Avebury

AN impressive view of the great stone monument of Avebury as the outstanding relic of prehistoric Britain was given by Mr. H. St. George Gray at the Society of Antiquaries on November 15, when he described the results of the excavations carried out by a committee of the British Association between 1908 and 1922. This was the first occasion on which these excavations, which were confined mainly to the southern side of the fosse, have been described comprehensively as a whole. The area of the site, according to the estimate accepted by Mr. Gray, is 28½ acres, and the imposing vallum and fosse are in circumference four times the size of the fosse at Stonehenge. Unfortunately, according to Mr. Gray's estimate, 95 per cent of the sarsen upright monoliths have disappeared. The present excavation at Avebury was originally one of a series of excavations of the rude stone monuments of Britain undertaken by the British Association committee with the view of ascertaining their age. According to the evidence obtained at Avebury, there can be little doubt that this site belongs to the period of transition between the neolithic and bronze ages. No trace of metal was found in the lower levels of the fosse, and the tools of stone, antler and bone, picks, shovels, rakes and hammers, are such as may be regarded as characteristic of a stone age industry. The pottery supports this, being of the 'Peterborough' type. The occurrence of this type of pottery in the lower levels at Avebury bears out the evidence of dating obtained by Mr. Alexander Keiller nearby in his work of exploring and restoring Kennet Avenue (see NATURE, Oct. 13, p. 566).

Augusta Treverorum

EXCAVATIONS in the Altbach Valley, near Treves, on the site of the Roman city of Augusta Treverorum, which had been intermitted for a period owing to a lack of funds, are now to be resumed under the continued direction of Prof. Loeschke. The excavation of an area which is so rich in antiquities as to have been termed the German Delphi has now been in progress for ten years. In addition to an amphitheatre which ranks among the most remarkable monuments of Roman antiquity, the site has revealed a wealth of archæological material covering a period extending from the stone age to the middle ages, as well as settlements which range from prehistoric to late Roman and Frankish times. The large number of shrines, altars and other cult objects which have been found indicate that this area was held in special veneration from very early times and continued to be an important centre of pagan religious worship down to the conversion of the Empire to Christianity. According to a dispatch in the *Times* of November 16, it is proposed to transform the area into a vast open-air museum, containing reconstructions of the most important monuments of each period. This is to form an integral part of the town-plan of Trier, and will be approached by a Via Archæologica running through the city and embodying in its course the most important of the city monuments, such as the cathedral and the palace of the Electors. This plan will take ten years to complete.

Control of Traffic by Light Signals

THE earliest light signals for controlling traffic were operated manually by the police. The next type were operated on a 'fixed-time' basis by purely mechanical devices. A later development is to link up a number of local fixed-time controllers with a master controller so that the indications all along a main traffic route bear a definite relationship to one another, with the object of maintaining a steady flow of traffic. An important example of this type is installed in Oxford Street, London. The latest and most popular types of signals are those which are operated by the passing vehicles themselves. There are two systems of this type in general use, and both use a detector mat placed in the roadway. In one system, the compression of the mat actuates an electro-pneumatic contact box placed in the pavement and only responds when the vehicle is approaching the crossing. A vehicle 'parking' on the mat has no effect on the signal. Suspended signals, which are fairly common abroad, divert the attention of the driver from the road level, and the drivers of modern saloon cars have difficulty in seeing them. The British signals are sometimes criticised because,

unlike the 'clock-face' or 'Chinese-lantern' type of signal used frequently in Switzerland and Germany, they give no indication of the length of time that the red or green indication has to remain. They are objectionable as they induce many drivers to accelerate to high speeds in order to pass the signals before they change. The uncertainty of the time of change in the usual type forces the driver to go slowly and this leads to safety. It is probable that vehicle-actuated signals will come into general use in England, and this would make 'clock-face' signals with their fixed time sequence of events practically impossible. An illustrated article on "Traffic Light Control Systems" appears in *Electrical Industries* of November 15.

Additions to British Museum Collections

SEVERAL interesting additions to the archæological and ethnographical collections of the British Museum have been made recently. Among them is a fine totem pole from the Nass River, British Columbia, which is figured and described in the *British Museum Quarterly*, 9, No. 1. The pole was acquired by purchase through Dr. Marius Barbeau, who has collected the legends attached to it. It is about 25 ft. high and originally was surmounted by an eagle, now lost. The figures represented from the top downwards are the 'Geebelk', a fabulous monster with wings and human face, but with a beak instead of a nose, an eagle, a large beaver with a small one on its back, and a sea-monster known as 'the man underneath'. From information obtained locally, this appears to be one of the oldest totem poles on the Nass and one of the finest. Another notable addition to the Department of Ethnography is a series of ancient Peruvian textiles from pre-Spanish cemeteries at Nasca, presented by Mr. Henry van den Bergh. They are excellent examples of the polychrome weaving practised by the coastal tribes, the colours being red, yellow, green and black. They may be dated roughly as belonging to the period 200 B.C. to 200 A.D. Adequate examples of the textile art of this area and period had not previously been acquired by the Museum.

Finsbury Technical College and the Central Institution

IN a recent number of the journal of the old students of the City and Guilds (Engineering) College, the *Central*, is a characteristic article by Prof. H. E. Armstrong on "The Beginnings of Finsbury and the Central". Finsbury Technical College in Leonard Street and the Central Institution in South Kensington were both the outcome of the formation in 1877 of the City and Guilds of London Institute for the Advancement of Technical Education, and Prof. Armstrong's article will be read with interest by all those who have been connected with those institutions or the many notable men who held office in them. With Prof. Armstrong at Finsbury were Ayrton and Perry, "the Japanese twins". "We were three of the rankest radicals ever brought together, dissatisfied with the narrow formal teaching then given, each of us with clear-cut constructive ideas for its practical improvement. We were bent on developing a rational experimental course of instruction, suited as we thought, to the coming needs of students who were to enter industry". So writes Prof. Armstrong, who after a short time was, with Ayrton, appointed to the Central Institution, where he had as colleagues Henrici and Unwin, who "were both dead set in their ideas, and took no special interest in developing method". "The 'Finsbury Spirit' never descended upon the Central Institution and other colleges set up to rival it and some day Leonard Street will figure upon the map as a small oasis in the midst of a great London educational desert". A sketch of the history of Finsbury College was given in the *Central* of July 1933.

Map of the Roman Empire

WE have received from the Ordnance Survey the Aberdeen sheet of the International Map of the Roman Empire on the scale of 1 to 1,000,000. The sheet covers the greater part of Scotland north of the Firth of Forth. Heights are shown by layer colours of two tints of green and three of brown. Spot heights in metres give actual altitudes; there are no contour lines. Modern names are confined to those of water features, and they are printed in blue. Roman features and place-names, which are of course few on this sheet, appear in black. Tribes are named in red. Forts, temporary camps and signal stations are differentiated. There is only one Roman road. Scales and index to adjoining sheets appear in the margin. The sheet is a beautifully clear piece of colour printing.

Protection against X-Rays and Radium

THE British X-Ray and Radium Protection Committee has recently issued a fourth revised report. It includes recommendations on the working hours for whole-time X-ray and radium workers. In addition to formulating precautions that should be observed by these workers, the report also deals with the safe use and storage of inflammable films, the safe use of electromedical apparatus, and precautions to be observed in the application of ultra-violet treatment and to ensure proper dosage. The Protection Committee will welcome suggestions or information which might tend to improve its scheme of protection outlined. Copies of the report may be had on application to the Secretaries, 32 Welbeck Street, W.1, or to the Director, National Physical Laboratory, Teddington, Middlesex.

Exhibition of International Architecture

ON November 30 H.R.H. the Princess Royal is to open an Exhibition of International Architecture at the new headquarters of the Royal Institute of British Architects in Portland Place, the inauguration ceremony of which was performed by the King and Queen early this month. The Exhibition will be the first of its kind ever held, and will provide a comprehensive panorama of modern building and planning. It will be divided into ten sections, illustrative of the whole of modern life. There will be, for example, a section devoted to planning for pleasure, containing

examples of modern road-houses, inns, theatres, cinemas and so on. Other sections will deal with planning for health, for dwellings, for commerce, for transport and for religion.

Announcements

MR. THOMAS ROWATT has been appointed director of the Royal Scottish Museum, Edinburgh, in succession to the late Mr. E. Ward.

DR. JAMES DAVIDSON, lecturer in the Department of Pathology in the University of Edinburgh, has been appointed officer in charge of the scientific laboratory which is to be instituted at the Metropolitan Police College at Hendon. Dr. Davidson's main function will be to assist in the investigation of criminal cases, to give instruction in scientific methods of crime detection to students at the College and at Peel House and to other members of the force, and to undertake research work.

THE following have been elected as officers of the Cambridge Philosophical Society for 1934–35 : *President*, Prof. J. Barcroft ; *Vice-Presidents*, Profs. E. K. Rideal, A. Hutchinson, and E. D. Adrian ; *Treasurer*, Mr. F. A. Potts ; *Secretaries*, Mr. F. P. White, Dr. J. D. Cockcroft, Dr. H. H. Thomas ; *New Members of Council*, Prof. G. H. Hardy, Dr. E. G. Holmes, Dr. M. Born.

THE following appointments have recently been made by the Secretary of State for the Colonies :— Mr. H. K. Ashby, to be agricultural officer, Malaya ; Mr. L. L. Carrington, to be agricultural officer, Jamaica ; Mr. J. Cook, to be agricultural officer, Malaya ; Mr. W. A. Gordon, to be assistant conservator of forests, Gold Coast ; Mr. A. K. F. Nicol, to be assistant conservator of forests, Nigeria ; Mr. D. F. Stewart, to be inspector of plants and produce, Gold Coast ; Mr. R. J. M. Swynnerton, to be agricultural assistant, Tanganyika Territory ; Mr. H. Gillman (agricultural assistant), to be district agricultural officer, Tanganyika Territory ; Mr. J. P. Maule (late superintendent of agriculture, Nigeria), to be manager, Government Stock Farm, Cyprus ; Mr. A. E. Moss (inspector of plants and produce), to be agricultural superintendent, Gold Coast.

WE have received an advance copy of a programme of the second annual exhibition of microscopes, conducted by Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C. The exhibition is to be held at the Central Hall, Westminster, S.W.1, during the week commencing December 10 from 2.30 p.m. daily, and admission is free. About one hundred microscopes will be arranged to display specimens illustrating pond life, botany, biology, pathology, bacteriology, petrology, metallurgy, Nature study and other types of study and research. There will also be a number of lantern lectures and cinematograph displays on the use of the microscope for various purposes.

IT is proposed to hold annually at the London School of Hygiene and Tropical Medicine a two-day conference in order that medical officers in industry on leave from the tropics may be able to meet and exchange views on the problems peculiar to their particular industries and to the areas where they are practising. The main subject for discussion will be the prevention of disease, for example, control of malaria and epidemic diseases in the tropics ; water supplies ; sewage and refuse disposal ; housing ; the keeping of records ; and hygiene generally. The conference each year will be held in July ; further information can be obtained from the Organising Secretary, Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A junior scientific officer in the William Froude Laboratory of the National Physical Laboratory, Teddington, Middlesex—The Director (Nov. 26). An assistant engineer in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1 (Nov. 26). A technical research assistant in blast furnace investigation in the British Iron and Steel Federation—The Secretary, Iron and Steel Industrial Research Council, Caxton House, Tothill Street, Westminster, S.W.1 (Nov. 27). A vice-principal of the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Nov. 30). A scientific officer in the Department of Scientific and Industrial Research—The Establishment Secretary, 16, Old Queen Street, Westminster, S.W.1 (Nov. 30). A geologist in the Department of Industry and Commerce—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (Nov. 30). A physicist in the Sheffield Radium Centre—The Secretary, Sheffield Radium Centre, Royal Infirmary, Sheffield, 6 (Dec. 1). A superintendent of commercial horticulture under the Middlesex County Council—The Secretary to the Education Committee, 10 Great George Street, Westminster, S.W.1 (Dec. 7). Lecturers in chemistry, land surveying and zoology in the University of Cape Town—Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London (Dec. 12). A chemist in the Archæological Museum, Palestine—The Director of Recruitment (Colonial Service), 2, Richmond Terrace, Whitehall, London, S.W.1 (Jan. 1). A technical assistant secretary of the Institution of Gas Engineers—The Secretary, 28, Grosvenor Gardens, London, S.W.1. An abstractor of scientific and technical literature for the British Cotton Industry Research Association —Director of Research, Shirley Institute, Didsbury, Manchester. Two engineer sub-lieutenants in the Royal Indian Navy—The Secretary, Military Department, India Office, Whitehall, S.W.1. An assistant to the Advisory Economist at the Midland Agricultural College—The Principal, Sutton Bonington, Loughborough.

ERRATUM.—In NATURE of November 17, p. 770, col. 1, lines 14–15, for "Sir William Herschel" read "Sir John Herschel".

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electric Deflection of Cosmic Ultra-Radiation

FOR the purpose of an analysis of the cosmic ultra-radiation I have succeeded in deflecting the radiation by strong electric fields. This method is considerably more convenient for the investigation of cosmic ultra-radiation than the use of magnetic fields. The following gives the results obtained with fields of 700 volts and 70,000 volts per centimetre.

Four Geiger-Müller tube-counters of 35 cm. length and 2·7 cm. diameter are placed vertically one above the other, the axes in the east-west direction. The distances apart of their axes are: 6·0 cm. from the first to the second, 140·0 cm. from the second to the third, and 36·0 cm. from the third to the fourth. A plate condenser of 2·8 cm. plate distance, 40 cm. broad and 121 cm. long stands symmetrically between the second and the third tube. The counters are arranged to work in the usual coincidence method adopted for cosmic rays. The absorption in the whole apparatus is equivalent to 1·0 cm. of lead; over the apparatus there are also two covers of reinforced concrete and the roof of the building. The fourth and lowest tube-counter can be displaced to each side.

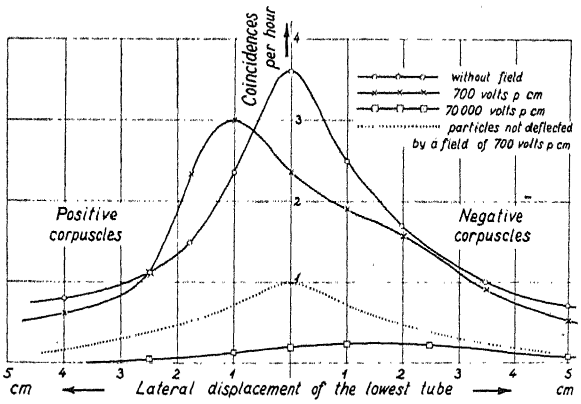

FIG. 1.

The uppermost curve in Fig. 1, giving the coincidences per hour, is then found without a field. At a field of 700 volts per centimetre in the condenser, 1 cm. deflection corresponds to particles of 1×10^7 electron volts. In this case we obtain more positive than negative corpuscles, if we take the difference between this curve and the curve indicating the non- or less-deflected particles. The latter form a similar curve to that without a field, with about 1·0 coincidence an hour in the centre. (Deflection $\leqslant 0 \cdot 5$ mm. corresponds to particles $\geqslant 5 \times 10^8$ e. volts, dotted curve in the figure.) At 70,000 volts per centimetre, there are more negative than positive corpuscles of 1–2 cm. deflection (1 cm. corresponds to $1 \cdot 0 \times 10^9$ e. volts). Without a field the mean statistical error of the measured points is 5 per cent, at 700 volts per centimetre it is 10 per cent and at 70,000 volts per centimetre it is 30 per cent; accidental coincidences have no effect.

I presume that the deflected particles observed with a field of 700 volts per centimetre correspond to the 'shower' particles, whilst the particles observed with a field of 70,000 volts per centimetre are chiefly primary corpuscles. The measurements are being continued with different fields in order to make an exact analysis of the radiation.

I wish to express my thanks to Prof. E. Regener for his kind help, and to the W. G. Kerckhoff Stiftung, Bad Nauheim, for providing funds for obtaining the condenser and the tube-counter in 1933, after preliminary work had been done since 1932.

ERNST LENZ.

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Oct. 30.

Use of the Centrifuge in Determining the Density of Small Crystals

THE accurate measurement of crystal density has recently acquired increased importance, since it is necessary to know this quantity in order to use X-ray methods for determining the molecular weights of unknown chemical substances. But the usual crystallographic methods of density measurement, using the specific gravity bottle or flotation of the crystals under gravity in liquids of known density, cannot easily be made to give accurate results where only small quantities of very finely crystalline material are available. We have therefore recently applied the centrifuge in the second of these two methods to hasten the settling of floating crystals, just as the centrifuge is used by biologists in the measurement of the densities of living cells.

The density determination even of minute crystals can then be made a very rapid process. In our experiments a small quantity of the substance under examination (about 0·05 mgm. or less) was introduced into a suitable liquid in a small test tube and all air bubbles removed from the liquid and crystals by evacuation in a vacuum desiccator. The test tube was then placed in a centrifuge and spun for 1–2 min. at a speed of 2,000–4,000 rev. per min. According to whether the crystals sank or rose under the centrifugal force, heavier or lighter liquids were then added to the tube and the process repeated until finally a liquid was obtained in which no movement of the crystal could be observed. At this point the density of the liquid is that of the crystals. The limits of experimental accuracy could very easily be followed by slightly changing the density of the liquid on either side of the mean until the crystals began definitely to rise or sink.

So far we have used this method to determine the density of the following five crystals: vitamin B_1 hydrochloride, supplied by Prof. Peters, and the hydrocarbons '$C_{21}H_{16}$', '$C_{25}H_{24}$', '$C_{26}H_{26}$', '$C_{27}H_{28}$', obtained by selenium dehydrogenation of cholic acid, cholesterol, ergosterol and phytosterols respectively and given us by Prof. Ruzicka. The density of vitamin B_1 HCl, which is water soluble, was measured in a mixture of bromonaphthalene and xylene. The hydrocarbons were soluble in organic solvents and here aqueous sugar solutions proved most satisfactory. To overcome difficulties due to the high surface tension of water, the hydrocarbons were first introduced into a drop of sodium taurocholeate solution which was

then made up to the approximately correct density with the sugar solution. Owing to the high viscosity of the sugar solutions, it was found necessary to increase the centrifuge period to 5–7 minutes in the neighbourhood of the neutral point, but the high viscosity has also the advantage of lessening the danger of convection currents disturbing the equilibrium during the slowing down of the centrifuge.

The table below shows the values of the densities observed and the molecular weights deduced in certain cases from these and previously obtained X-ray measurements.

TABLE 1.

Substance	Density	Molecular Wt. Obs.	Molecular Wt. Calc.
Vitamin B_1 HCl	1·403 ± 0·003	351 ± 8	
$C_{21}H_{16}$	1·244 ± 0·002		
$C_{25}H_{24}$	1·195 ± 0·003	327 ± 7	324
$C_{26}H_{26}$	1·158 ± 0·003	341 ± 5	338
$C_{27}H_{28}$	1·135 ± 0·002		

Further work is in progress to increase the accuracy of the X-ray measurements of these compounds.

We have to thank Prof. R. C. Peters and Prof. R. Robinson for permitting one of us to use centrifuges in the Department of Biochemistry and Dyson Perrins Laboratory, Oxford.

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D. CROWFOOT.

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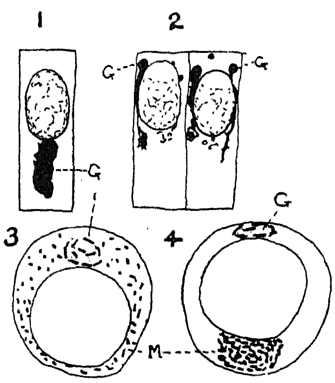
Use of the Ultra-Centrifuge for Studying the Golgi Apparatus

IN some recent work[1] it has been shown that the Golgi apparatus of the uterine gland cells of the guinea pig passes centripetally when pieces of uterus are centrifuged 400,000 times gravity by the ultra-centrifuge of J. W. Beams. This effect is shown in Figs. 1 and 2; in Fig. 1 the control Golgi apparatus lies as a dark mass towards the lumen of the gland. When centrifuged, the material of the Golgi apparatus passes up as streamers between the nucleus and the cell wall to the upper region, apparently being lighter than the surrounding cytoplasm.



Recently we have extended this work to the spermatocytes of *Helix*. These were studied intravitally by Platner[2] and others about the year 1885, and have been the subject of several monographs in recent years. As in many other types of cells, both Golgi apparatus and mitochondria are visible in the living cells. The control cell is shown in Fig. 3, the centrifuged cell in Fig. 4. In many cases complete separation of the two categories of cytoplasmic inclusions is effected.

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J. A. MULLIYIL.
J. BRONTË GATENBY.

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Oct. 27.

[1] Beams and King, *Anat. Record*, 1934.
[2] Platner, *Arch. mikr. Anat.*, 25, 1885.

Aluminium Coating of Gratings

DR. SPENCER JONES, the Astronomer Royal, in a recent article[1] on the use of aluminium for coating glass reflecting mirrors, has dealt with its application to astronomy. We have recently carried out, at the Solar Physics Observatory, Cambridge, some tests on the behaviour of a speculum-metal grating which had been kindly coated for us with aluminium by the process of evaporation by Mr. C. H. Walker, of Metropolitan-Vickers Electrical Co., Ltd. The tests were made with a laboratory spectrograph with a calibrated wedge over the slit; photographic plates were cut into half and the two halves were exposed under identical conditions before and after the grating had been coated, and were developed in pairs together. The plates were examined with the observatory recording microphotometer.

In substantial agreement with Strong[2] we found a greater improvement in the shorter wave-lengths, and an average increase in the reflectivity of about 50 per cent. The process appears to transfer light from one order of the spectrum to another, for in this case all orders on one side of the central image gained considerably more than the corresponding orders on the other side, the first and third orders being improved more than the second. In one case, at 4870 A. in the second order, there was actually a loss of 30 per cent on one side, and a gain of 80 per cent on the other side of the central image. The greatest improvement at any point examined was at 3700 A. in the third order, where the improvement was 50 per cent on one side, and 120 per cent on the other. An improvement of 50 per cent and 100 per cent in the first order at 3800 A. was also obtained. The definition of the grating was unaffected by the coating.

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F. J. M. STRATTON.

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Oct. 31.

[1] NATURE, **134**, 522, Oct. 6, 1934.
[2] *Pub. Ast. Soc. Pac.*, **46**, 25; 1934.

Measurement of the Current Generated by a Rectifier Photoelectric Cell

CAMPBELL and Freeth[1] have described a method of measuring the current generated by a rectifier cell in such a way as to reduce greatly the disturbing effect of the internal leakage which occurs in these cells. This varies with temperature and intensity of illumination and may cause large curvature of the light-current characteristic in strong light. This method consists in the insertion of a variable external source of potential, obtained from a potentiometer

arrangement, in series with the cell and the galvanometer or micro-ammeter, M, used for measuring the current, and the connexion of a second galvanometer, G, directly across the terminals of the cell. The potentiometer is adjusted until a zero reading of G is obtained. M then measures the current, and the absence of potential difference between the cell terminals greatly reduces leakage currents, though small internal potential differences may occur between the back plate and parts of the front conducting film, which cannot be at the same potential throughout owing to its appreciable resistance.

We have found the following very slight modification of this circuit to be eminently suitable for measuring illuminations ranging from full sunlight to a small fraction of a metre candle. We employ as a source of potential a standard potentiometer of known resistance, and replace the micro-ammeter, M, by a known resistance, R, which may conveniently be varied from 100 ohms for full sunlight up to 100,000 ohms for very weak light. If a sufficiently sensitive null point indicator is available, R may with advantage be increased still further, thus giving an enormous range of sensitivity. Since there is no potential differences across the cell and null point detector, G, their resistances make no difference, and the current is immediately deducible from the setting of the potentiometer and the value of R. We must, of course, ensure that the contacts of the potentiometer, which is itself used in an unbalanced condition, are in good order, and correct for the potentiometer resistances when finding the current.

For work at sea, where the motion of our small ship precludes the use of a sensitive galvanometer, G may be replaced by the interrupter amplifier telephone combination which we have always used for submarine work. Laboratory tests have shown that this combination works very satisfactorily, and it is almost certain that it will be equally suitable for measuring deep water illumination, combining, as it does, the advantages of great current sensitivity with the moderation of curvature of the light-current characteristic which is only obtainable for rectifier cells by the use of a current-measuring instrument of low effective resistance. We hope to describe the experimental details which we have found to be convenient, and to give some results obtained by the use of the method, in a paper which we are offering to the Royal Dublin Society.

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Royal Dublin Society.
W. R. G. ATKINS.
Marine Biological Laboratory,
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Oct. 30.

[1] *J. Sci. Instru.*, **11**, No. 4, April 1934.

Raman Spectra of Decahydro- and Tetrahydro-Naphthalene

THE Raman spectra of decahydro- and tetrahydronaphthalene have been studied by me with the view of recording the faint lines and assigning the frequencies correctly. These liquids were studied previously by G. B. Bonino and P. Cella[1], who reported a large number of lines for each of these substances. Whenever a substance has a large number of Raman lines, and if no suitable filter is used to cut off the light of the 4046 group of lines of the mercury arc, and only one strong mercury line is used as the exciting line, for example, the 4358·8 A. mercury line, there is always the possibility of wrong assignment. Hence, in the case of such substances it is desirable to use a suitable filter to cut off the 4046 group of mercury lines. After trying several filters one after another, I found ultimately a filter of *m*-dinitrobenzene dissolved in suitable proportions in benzene to be very efficient in weakening considerably the 4046 region of the mercury arc. This filter had previously been used very successfully by R. Bär[2], using carbon tetrachloride as the scattering liquid.

In the present investigations I have taken two spectrograms using tetralin, one with a quinine sulphate filter which only partially weakened the 4046 region, and the other with a filter of *m*-dinitrobenzene dissolved in benzene. The latter filter weakened considerably the light of the 4046 region and more of the shorter wave-length radiations. A comparison of the two plates, and also a consideration of the relative intensities of the lines on each plate, gave the origin of each Raman line. In the use of dekalin I have obtained one spectrogram using the latter filter. I have subjected the liquids to repeated distillation and have used only the middle portion of the distillate and taken special care to make the liquids dust-free.

Bonino and Cella[3] have reported altogether 41 lines in the case of tetralin. Thirty-eight of these lines have been observed on my plate and they agree remarkably well with their results.

In addition, I have been able to obtain on my plate twelve new lines not recorded before, at wave-numbers: 19892, 19998, 21833, 21864, 22239, 22715, 23100, 23203, 23814, 24001, 24371 and 24446. In the case of dekalin, Bonino and Cella reported 16 Raman lines as due to 4358 A. excitation. I obtained all these lines on my *m*-dinitrobenzene in benzene filter plate. The agreement here is also very close. In addition, dekalin has given seventeen new frequencies on my plate at wave-numbers 19702, 19761, 20046, 21588, 21665, 21881, 22005, 22495, 22562, 22586, 22614, 22644, 22765, 22784, 23082, 23098 and 23173.

On my plates, tetralin and dekalin each show three anti-Stokes lines not previously recorded, at wave-numbers 162, 265, 1433, and 596, 494 and 407 cm.$^{-1}$ respectively.

Tetralin shows a large number of Raman lines owing to the presence of the aromatic ring and the carbon hydrogen linking in addition to the aromatic linking C=C in its molecule. As reported by Bonino and Cella, it shows one line at 3046 cm.$^{-1}$ characteristic of the aromatic carbon hydrogen linking, and another at 1582 cm.$^{-1}$ of the aromatic linking C=C. Five other lines which are present in the naphthalene spectrum and are due to the CH groups have been obtained at frequencies 1376, 1283, 1174 and 1037, 582 and 511 cm.$^{-1}$ and they confirm the previous authors' results; but the sixth line at 938 (0) cm.$^{-1}$ reported by them was observed on none of my plates. Two other new frequencies obtained by me are at 2940 and 699 cm.$^{-1}$. They are both present in the cyclohexane spectrum as has been reported by P. Krishnamurti[4]. The former is characteristic of the carbon hydrogen linking in the : CH_2 group. The latter has been reported to be present as a very weak line in benzene at 694 cm.$^{-1}$ by S. Bagwantam[5], which, he reports, agrees remarkably well with a strong infra-red absorption found by Coblentz[6] at 694 wave-numbers.

Dekalin shows three frequencies at 2922, 2892 and 2855 cm.$^{-1}$, only two of which were previously reported by Bonino and Cella, characteristic of the carbon hydrogen linking in the : CH_2 group and also one at 1447 cm.$^{-1}$ as reported by these authors. They are all present in the cyclo-hexane spectrum also reported by P. Krishnamurti. Six other lines which are present both in the cyclo-hexane and naphthalene spectra[7] have been obtained at 1362, 1256, 1166, 1024, 991 and 596 cm.$^{-1}$, and they also confirmed the previous authors' results.

Among the other new unrecorded frequencies given by dekalin are three weak lines at 2658, 443 and 376 cm.$^{-1}$, all of which are present in the cyclo-hexane spectrum according to P. Krishnamurti.

A full report of these investigations will be published shortly.

I am indebted to Sir C. V. Raman, in whose laboratory at Calcutta these investigations were carried on until I left Calcutta early in January 1933. During the past year, while working in Prof. O. W. Richardson's laboratory, King's College, I have been permitted by him to use the micro-photometer, and by Dr. W. E. Williams to use the comparator, in measurements of Raman lines. It is through these facilities that I am now able to give the results of my investigation.

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Oct. 15.

[1] *Rendiconti Reale Accad. Roma*, **13**, 784; 1931. Also, *Atti. Accad. Lincei*, **15**, 572–576; April 3, 1932.
[2] *Helv. Phys. Acta*, **5**, 174; 1932.
[3] Loc. cit.
[4] *Ind. J. Phys.*, **6**, 543; 1932.
[5] *Ind. J. Phys.*, **5**, 515; 1930.
[6] "Investigations of Infra-red Spectra". Carnegie Inst. (1905).
[7] R. Bär, NATURE, **124**, 692, Nov. 2, 1929.

Magnetic Properties of Organic Vapours

VERY little work has so far been done on the magnetic susceptibilities of organic vapours. Vaidyanathan's[1] experiments indicate that in the case of some liquids, such as benzene, carbon disulphide, pentane and hexane, there is considerable divergence between the liquid and vapour values. Sivaramakrishnan's[2] careful measurements by a new method[3] developed in this laboratory also gave a similar result in the case of benzene (a molar susceptibility of $79 \cdot 6 \times 10^{-6}$ for the vapour and $54 \cdot 6 \times 10^{-6}$ for the liquid).

In a recent note[4], we pointed out that these apparent differences were due to the fact that in the calculation of the molar susceptibility of the vapours, it was assumed that the vapours obeyed Boyle's law and that the susceptibility of 22·41 litres of the saturated vapour at N.T.P. would give the molar susceptibility. This assumption is obviously untenable. The correct method after determining the volume susceptibility of the vapour would be to calculate the specific susceptibility of the vapour, knowing the density of the vapour (available from the tables) at the specified temperature and pressure. We can thence calculate the molar susceptibility.

As an example, for benzene Vaidyanathan gives the molar susceptibility (in -10^{-6} units) for the liquid as 56, while his (uncorrected) values for the vapour, by two methods, are 83 and 74. When the results are recalculated by the above method, the values become 64·5 and 59·3; and Sivaramakrishnan's value (79·6) becomes 57·1.

For other organic vapours for which calculations have been made (details will be published elsewhere) the corrected molar susceptibilities agree equally well with the values for the liquid state. The only exception is carbon disulphide, for which the corrected molar susceptibility is still more than 30 per cent greater than in the liquid state; but here more accurate data are desirable, particularly in view of the fact that Vaidyanathan's results, by two different methods, differ by as much as 20 per cent.

It follows from the foregoing considerations that the calculated values of the molecular susceptibility depend on the accuracy of the density data. It seems to be desirable in new measurements to determine the density of the vapours directly along with the magnetic values.

In a recent letter in these pages, Jaanus and Shur[5] have mentioned that the difference of the magnetic susceptibility in the liquid and vapour states was mainly due to some mistake in the experimental work. We take this opportunity to point out that the differences are due mainly to certain untenable assumptions made in the calculations and not to experimental inaccuracies.

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Aug. 29.

[1] *Ind. J. Phys.*, **2**, 135; 1927.
[2] *Annamalai Univ. J.*, **3**, 48; 1934.
[3] *Proc. Phys. Soc.*, **46**, 318; 1934.
[4] *Current Science*, **2**, 475; 1934.
[5] NATURE, **134**, 101, July 21, 1934.

Parasitism of *Rhizoctonia lamellifera*, Small

IN the years preceding 1929, much controversy existed regarding the parasitism of the group of fungi known collectively as *Rhizoctonia bataticola*. The differences of opinion held by various sections of workers, and postulated principally by Small, Gadd and Briton-Jones, were largely attributable to the use of the one specific name *bataticola* for what now appears to be a relatively large group of sclerotium-forming fungi. Papers published by Ashby[1] in 1927 and Haigh[2] in 1930 showed that *R. bataticola* was a polymorphic fungus possessing a pycnidial stage, *Macrophoma phaseoli*, and was apparently distinct from two other forms which Haigh styled strain *A* and strain *B*. In 1933, I showed[3] that strain *A* was physiologically and morphologically distinct from both strain *B* and *M. phaseoli*, and suggested that it should be designated by Small's original binomial *R. lamellifera*. The question of parasitism I did not touch upon.

For the past eight years I have been experimenting with the object of producing infection in young plants by various strains of these fungi, but until a year ago was unable to obtain any certain results with *R. lamellifera*. Last year, however, by growing grapefruit seedlings on certain agar media under aseptic conditions and inoculating with a grapefruit strain of *R. lamellifera*, I obtained 100 per cent 'kill' in 24 plants after 9 weeks. Control plants on sterile agar and on media inoculated with (*a*) *M. phaseoli* and (*b*) a saprophytic *Phyllosticta* sp. remained green until after the agar had dried out—a matter of six months.

Infection was observed to begin at the root tip and proceed along the translucent roots for several inches, when the plants began to wilt. Soon afterwards, the fungus, growing on the surface of the medium, attacked the seedling at the 'collar', and very soon invaded the whole of the stem and leaves, causing the plant to die rapidly. A contributory factor appears to be water shortage.

Preliminary histological examination suggests that the fungus advances along the vascular system of the young root and does not penetrate the cortex except to form sclerotia.

Confirmatory evidence of parasitism under specialised conditions was obtained in later experiments.

There appears to be no authentic record of *R. lamellifera*, as distinct from members of the *bataticola* group, killing living plants, and as a number of workers have recently turned their attention to this group of fungi, it might be well if my experimental results were made known pending the publication of a full paper.

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Sept. 29.

[1] *Trans. Brit. Myc. Soc.*, **12**, 141; 1927.
[2] *Ann. Roy. Bot. Gard. Peradeniya*, **11**, 3; 1930.
[3] *Proc. Rhodesia Sci. Assoc.*, **33**, 65; 1933.

Bursting of Cell by Polarised Sunlight

AT a meeting of the Biochemical Society in November 1925, I read a paper on the "Hydrolysis of Starch in the Guard-Cells of the Leaf by Polarized Light". This work has since been amplified and confirmed, and some of the results were shown at a meeting of the Linnean Society in April 1933.

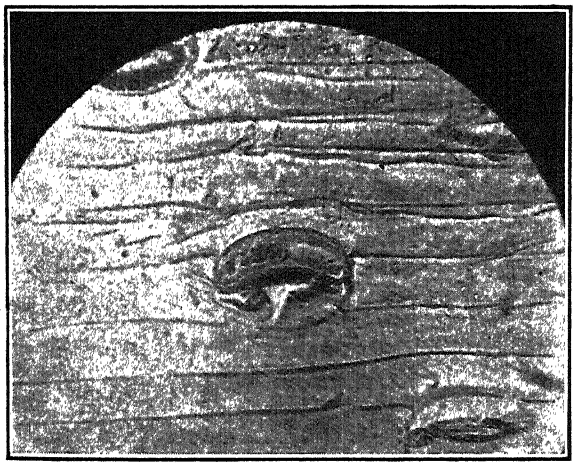

FIG. 1. Burst guard-cell after exposure to polarised sunlight.

In all these cases, diffused skylight, polarised by passage through a Nicol's prism, was used. As the Nicol cuts off a large proportion of the light, the illumination was comparatively weak. Recently, however, direct *sunlight* has been employed.

A young and healthy hyacinth plant was placed in a sunny window for two or three hours to allow the plastids of the stomata to form their full starch content. A Nicol's prism was then placed in front of a small portion of the leaf, which thus received *polarised sunlight*, the part covered by the cork rim of the Nicol being in comparative darkness and the rest of the leaf in strong sunlight. The results were most striking. Whereas in the earlier experiments with feeble illumination, the starch gradually hydrolysed to a reducing substance and the stomata opened and remained open, with this bright polarised sunlight the guard-cells burst and the contents were ejected to a distance, often as great as the long diameter of the stoma (Fig. 1). Staining with iodine showed that the starch had completely disappeared. The rapidly increased turgor, due to the hydrolysis, had ruptured the cell-wall. The guard-cells in the portion in darkness and in ordinary sunlight showed good starch content.

It was interesting to note that the maximum effect occurred along lines parallel to the length of the leaf. As the leaves of monocotyledons are slightly ridged, the stomata along some lines would receive fuller light than along others, owing to the difference in tilt of the surface.

Next spring it is hoped to make systematic experiments to determine the minimum time and intensity necessary to produce this violent explosion of the cell.

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Sheep Sweat a Factor in Blowfly Attack of Sheep

BLOWFLY attack of sheep is associated with bacterial activity in the wool. The part of the body most commonly attacked is the breech, which is the portion of the fleece most subjected to wetting; other parts of the body may be attacked if they are kept wet.

'Body strike' or fly attack on the wither, back or loin, is usually associated with excessive rains and humid conditions generally. Under these conditions, bacteria develop in the wool and produce what is known as 'weather stain'. If flies are prevalent, a certain proportion of the sheep exhibiting stain are struck. In field observations which we have made on weather stain and body strike, we have been able to study the conditions contributed by the sheep which predispose it to fly attack. The links in the chain of evidence are as follows:—

1. We have shown that there is a relation between yolk colour and susceptibility to weather stain and body strike; susceptibility increases with increase in intensity of yolk colour from white to yellow.

2. We have produced evidence for considering yellow yolk to be identical with 'golden colouration' of Rimington and Stewart[1].

3. On the evidence of Rimington and Stewart confirmed by Sutton[2], yolk colour is an index of sweat content.

We must conclude, therefore, that there is a relation between sweat content and susceptibility to weather stain and body strike.

Seddon, Belschner and Mulhearn[3] have shown that excessive wrinkliness of the breech is a factor which predisposes sheep to crutch strike. Bull[4] has shown further that in the skin folds of the crutch the "sweat glands are large, dilated and show hyperplasia of the lining epithelium". The wool yolk in folds is more

yellow than is wool on the crest of wrinkles and on Rimington and Stewart's analysis contains a high proportion of sweat. We have concluded, therefore, that sweat is probably a factor in crutch strikes as well as in body strikes.

Our evidence and conclusions are being published in detail in Pamphlet No. 48 of the Committee of the Council for Scientific and Industrial Research.

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Canberra, F.C.T., Australia.

[1] Rimington, C., and Stewart, A. M., *Proc. Roy. Soc.*, B, **110**, (B 765), 75–91; 1932.
[2] Sutton, W. G., *J. Text. Instit.*, **24**, 341–350; 1933.
[3] Seddon, H. R., Belschner, H. G., and Mulhearn, C. R., *Sci. Bull.* No. 37. Dept. Agr., N.S.W. 42 pp.; 1931.
[4] Bull, L. B., *Aust. Vet. J.*, **7** (4), 143–148; 1931.

Inland Water Survey

I HAVE read with interest the leading article on inland water survey in NATURE of October 27 and the comments on Mr. Alan Chorlton's letter in NATURE of November 10, and Prof. W. S. Boulton's letter in the issue of November 17.

It is becoming more clear that there is considerable opinion in favour of keeping the administrative hand in the position to control survey; and that undoubtedly means the subservience of the machinery of pure survey to the immediate requirements of regional committees and the like. This is where confusing results come in.

Prof. W. S. Boulton has, like many others, unfortunately, considered only water supply, whereas there are other water interests which are more dependent on water survey. It seems to be forgotten that the case for the independence of water survey is considered to be proved by the Inland Water Survey Committee of the British Association. It would be a great disaster if the next move towards a central water authority only resurrected the chaos of records, inquiries and the like which has characterised the past.

Undoubtedly, the dual aspect, which Prof. Boulton mentions, must be kept in mind, and this aspect is present in land survey organisation. The Ordnance Survey is under the Ministry of Agriculture and Fisheries, and it has been called upon for, and carried out, the boundaries of the catchment board authorities. There has been no step to follow up this piece of national survey by national water survey of rivers. Every water interest will have to take its part in the observational and record side of water; but it is imperative that there shall be a central survey authority for direction and supervision.

Looking at the matter from the point of view of efficient survey, it seems to be more important than ever that survey should be freed from the opposing interests of Ministries, first of all; and the Joint Committee of the British Association and Institution of Civil Engineers has stated fairly clearly the type of administrative control which might guide the activities of the water survey authority, and it has also put in a few lines what is the general scope of water survey.

Various views will undoubtedly be expressed by many people interested in the subject, but surely the views of those who have worked intimately at this problem for the last two years should receive the most careful consideration and even some practical development. The alternative is undoubtedly the easy course of placing the water survey authority under the Ministry of Health; but the danger is obvious. It seems impossible that this Ministry will be able to cut the interests of pure survey out of the hands of those who go very far to determine the actions of the Ministry. When the Admiralty and Ordnance surveys were founded, conditions were different from those now existing; and it may be doubted if a Ministry would now be regarded as the most suitable body to maintain those surveys or to create either water or air survey on equally efficient and economic lines.

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Diffusion of Gases through Metals

THE rate of diffusion of gases through metals has been found to be approximately proportional to the square root of the gas pressure, and is generally represented by the equation $D = K.\sqrt{P}$. Borelius and Lindblom[1] made accurate determinations of the rate of diffusion of hydrogen through various metals and found their results were more nearly represented by the empirical equation $D = K\ (\sqrt{P} - \sqrt{P_t})$ where P_t was a threshold value of pressure below which no diffusion took place.

We have measured the rate of diffusion of hydrogen through copper, nickel, iron and molybdenum and nitrogen through molybdenum. We confirm the departure from the square root law at low pressures, but not the existence of a definite threshold value of pressure. At low pressures the rate of diffusion falls off, becoming progressively less than would be expected from the square root law. It appears to us that the effect of adsorption on diffusion has been neglected, and that if this is taken into account the experimental results can be satisfactorily explained. Diffusion must be preceded by adsorption on the surface, and the rate of diffusion must be proportional to the amount of gas adsorbed. Diffusion measurements are not generally made under conditions where a complete unimolecular layer is adsorbed, so that with each increase in pressure a larger fraction of the surface becomes covered. This factor may be included in the diffusion equation by introducing the Langmuir isotherm $\theta = \frac{ab\,P}{1+aP}$ where θ is the fraction of the surface covered by adsorbed molecules. The diffusion equation then becomes $D = K\ (\frac{abP}{1+aP})\ \sqrt{P}$, which satisfactorily represents our experimental results.

We have also checked this equation by inserting the adsorption constants obtained from Gauger and Taylor's[2] isotherms for hydrogen and nickel, plotting the curve, and extrapolating the sensibly straight part until it intercepts the pressure axis. The value of pressure obtained in this way is in close agreement with the so-called threshold value found by Borelius and Lindblom for the same system.

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[1] *Ann. Phy.*, **82**, 201; 1927.
[2] *J. Amer. Chem. Soc.*, **45**, 924; 1923.

Research Items

Physical Characters of a Scottish Bishop. The skeletal remains of Bishop James Kennedy, born about 1408, and bishop of St. Andrews from 1440 until 1468, when he died, have been studied from the anthropological point of view by Dr. David Waterston, professor of anatomy in the University of St. Andrews (*Trans. Roy. Soc. Edinburgh*, 58, Pt. 1, No. 4). Although very little is known of the personal life of the bishop, he was undoubtedly one of the more prominent figures in an obscure period of Scottish history. Not only does this examination of his remains serve to throw light on the physical characters of the dominant classes in Scotland at that period, but it also provides material for a comparison with the physical characters of Robert the Bruce, whose skull has been the subject of anthropological investigation, and from whom Kennedy was descended through his mother. Dr. Waterston's examination was made possible by restorations in the chapel of the United College of St. Salvator and St. Leonard in 1930 which led to the opening of the tomb; but the remains, it is known, had been exposed on previous occasions, while the present interment dates only from 1863. There is, however, no doubt of their authenticity. They indicate a stature of 173·5 cm. (5 ft. 8 in.–5 ft. 6 in.), broad shoulders and powerful muscles. In fact, they are those of a person who had led a life of physical activity. The arms were a little longer than usual, and a functional development of the muscle on the right ulna suggests the habitual pursuit of some activity, such as fencing. The skeletal evidence of right-handedness is confirmed by the asymmetrical endocranial cast of the brain. The heart had been removed after death for separate interment. There was evidence of rheumatoid arthritis. The cranial and facial skeleton was nearly, but not quite, complete. The cranium was dome-shaped with full and rounded outline, the facial skeleton well-developed and powerful, with prominent zygomatic bones, strong mandible and prominent chin. The length-breadth index is 78·8. The skull closely resembles the typical Scottish skull as defined by Sir William Turner; but it presents some marked and interesting differences from that of Robert Bruce.

Pygmies and Bushmen. The problem of the relationship of the African pygmies and the Bushmen of South Africa has once more been raised by Dr. Walter Hirschberg, who briefly reviews the theories which have been put forward from time to time and makes certain suggestions of his own in *Africa* (vol. 7, No. 4). The theory of racial affinity has been supported by, among others, Schweinfurth, von Luschan, E. Fischer and P. W. Schmidt, and opposed by Sir Harry Johnston, P. Poutrin and R. Pöch. Schapera regards them as divergent specialised branches of a small variety of Negro. Other investigators have pointed to remnant peoples of East Africa, such as the Ndorobo, Elgunono and Doko, among whom traces of Bushman-like population are conspicuous, the reasons given being predominantly linguistic, though somatically the resemblance is to the Hottentot. To-day, the pygmies and Bushmen represent two highly specialised cultures and racial types. Their economic pursuits appear to be definitely determined by environment and cannot be taken as proving or disproving affinity. Bushman culture consists of a variety of elements, one of which may well have originated from pygmy culture; but this by no means justifies using it as a proof of relationship. Divergences in the two cultures outweigh resemblances. A fundamental difference seems the inevitable conclusion. One element of Bushman culture which points to East Africa is the resemblance in the bow and arrow to that in use among the Kindiga. Another clue lies in the prehistoric relations that can be traced to East Africa in the Wilton, Smithfield and kitchen-midden cultures, which extend so far as Kenya and Uganda. Failing skeletal remains, the existence of a Bushman people cannot be established beyond the confines of South Africa. Neither Bushmen nor Pygmies are a uniform race and any relationship between them is highly improbable. Present-day Bushman culture is probably the product of a long period of development in that area.

Life-History of *Idiacanthus fasciola*. Dr. William Beebe has a fund of interesting information to offer on this peculiar fish ("Deep-Sea Fishes of the Bermuda Oceanographic Expeditions. Family Idiacanthidæ." *Zoologica. Sci. Contrib. New York Zool. Soc.*, 16, No. 4, March 1934). Most of the fish hitherto classified under the genus *Stylophthalmus* have proved to be the larvæ of *Idiacanthus*, which have enormously long-stalked eyes, the character being very specialised and correlated with many primitive conditions of teeth and skeleton. The change into sessile-eyed post-larvæ is by absorption of the optic nerve and the drawing down and coiling up of the cartilage stalk, followed by its inclusion into the anterior part of the eye socket, its complete covering with epithelium and final absorption. The males are very small and larvoid, without teeth, pelvic fin or barbel, but with a long caudal fin, bones slightly or not at all ossified, of simple larvoid shapes and relative positions. The digestive apparatus is atrophied after the post-larval stage, and the testicle is precocious in development. There is a large post-orbital cheek light corresponding to a very small one in the female. The author suggests that they are probably parasitic, the female doing the seeking. They are more numerous than the females, and have very weak swimming powers. The female is well adapted for swallowing large food, having an apparatus allowing a very great distension of the entire throat, and powerful teeth, the food being fishes of various kinds. *Idiacanthus* belongs to the sub-order Stomiatoidea and the family Idiacanthidæ, and there is only one genus known. All the Bermuda specimens belong to one species, *Idiacanthus fasciola*, including specimens hitherto referred to the family Stylophthalmidæ.

Development of the Tusser Caterpillar. S. Saito (*J. Fac. Agr., Hokkaido Imp. Univ.*, 33, Pt. 4; 1934) directs attention to the tusser worm, *Antheraea pernyi*, as a particularly favourable subject for the study of the development of a silk-spinning lepidopteran. The egg is 3–4 mm. in the longer and about 3 mm. in the shorter transverse diameter. Each female moth lays about 240 eggs. The author has employed about 25,000 eggs in this investigation. When the egg is fixed in Allen's modification of Bouin's fluid, the egg-shell or chorion becomes separated from the egg by a space which permits removal of the chorion by means of needles. The author first examined the development of the superficial features of the embryo,

and then studied the internal changes by means of serial sections. The thickened ventral plate, differentiated from the blastoderm, develops elevations at its four corners, the two anterior ones form the cephalic lobes and the two posterior ones the caudal lobes. Between the cephalic and caudal lobes is an unsegmented region from which a segment is first constricted off at its anterior end, and afterwards other segments are marked off one after another from before backwards, until 16 segments are produced of which three are cephalic, three thoracic and the remaining ten are abdominal. Each segment has a pair of appendages, but those of the first, second, seventh, eighth, ninth and tenth abdominal segments disappear, while those on the other segments become transformed into the limbs characteristic of the body regions to which they belong. The paper is illustrated by five plates.

Annelids from the Dutch East Indies. A collection of polychætes and Hirudinea from the Dutch East Indies is described by H. Augener in *Treubia*, 14, No. 2, 1933. These belong to the Zoological Museum in Buitenzorg, Java, and several interesting points are noted. Young were found on the bristles of *Amphinome rostrata* from two localities. Several species of polychætes are common to these regions and to European seas, including such well-known British forms as *Odontosyllis fulgurans* and *O. gibba* (distinguished by their luminescent properties and found in their pelagic stages), *Branchiomma vesiculosum* and *Nereis* (*Platynereis*) *dumerili*. The last-named, which is usually marine, occurred in water of low salinity in a small island off Java, and *Lycastis ranauënsis*, a fresh-water nereid from Sumatra, is also recorded from Java. 29 species belonging to 10 families, and 21 genera are dealt with in this work.

Seasonal Nitrogen Cycles in Fruit Trees. A useful paper by Dr. D. V. Karmarkar (*J. Pom. Hort. Sci.*, 12, No. 3, Oct. 1934) traces the seasonal changes in moisture and nitrogen contents of apple trees, and changes several empirical beliefs into demonstrated facts. It has been found that the water content of the wood and bark rises through the periods of bud swelling to a maximum in June. Young leaves have high water content, and so have leaves during defoliation. Neither of the cultural treatments mentioned in the title of the paper, namely, grass plus annual spring nitrate, or arable without nitrogenous fertiliser, seemed to have any appreciable effect on the times of seasonal changes in water or nitrogen contents. Well-defined changes occur in the amounts of total soluble materials, total nitrogen, protein and non-protein nitrogen, and in the various fractions of the latter. The results show that, in general, trees grown on arable land have a higher turnover of nitrogen than trees grown on grass, and many more conclusions are set forth in detail. Dr. T. Wallace, of Long Ashton Research Station, has prepared the actual account of the work under review, whilst Mr. J. O. Jones made several of the nitrogen determinations after Dr. Karmarkar left for India.

Rainfall Prediction in Northern Australia. In "Foreshadowing of Monsoonal Rain in Northern Australia" by H. M. Treloar (Bull. No. 18, 1934, Bureau of Meteorology, Melbourne) the problem of foreshadowing the seasonal rains of three Australian districts referred to as the Darwin, Pine Creek and Victoria River Downs districts is examined. These are regions where the rainfall is very markedly of the summer type, ninety per cent of the year's fall coming on an average in the five months, November–March. Of the three districts, that farthest south and most distant from the sea is one of importance in the rearing of cattle. Sir Gilbert Walker's method, in which purely statistical relationships have been found between the element to be predicted and other meteorological elements for some earlier period in distant regions, is used. The results take the form of a regression equation between departures from the normal of the various elements, and the efficacy of the formulæ can be gauged from the value of the multiple correlation coefficients, which for the three districts already mentioned amounted to 0·71, 0·51 and 0·57 respectively. A large part of this paper is occupied with a discussion of the best form in which to make the foreshadowing, the fundamental difficulty being that the amount of rain predicted in a given season will often, with correlation coefficients of the magnitude of these, differ greatly from the actual fall, and the method may be discredited in the opinion of practical farmers unconversant with statistical methods because of a single failure. The view is taken that Walker's recent system of restricting predictions to years when the departure from the normal indicated by the formula is above a certain limit does not meet the needs of many agriculturists and engineers concerned with water supply, and that it is better to give the foreshadowing in the form of 'odds' (say, 7 to 1) that the rainfall will be between certain specified limits.

The Siberian Meteor of June 30, 1908. The main phenomena of this great meteor have been described by Dr. F. J. W. Whipple in the *Quarterly Journal of the Royal Meteorological Society* (56, 287–304; 1930). Since that time, further details have been obtained from other sources, and these are summarised by Dr. Whipple in a recent paper in the same journal (60, 505–512; 1934). The unusual glows in the sky of northern Europe were observed during the nights of June 30–July 2. In Sweden they were so bright that good photographs could be taken at midnight on July 2, and in Scotland a photograph of Dornoch Cathedral was taken at the same time with an exposure of 90 seconds. There is no record of any observation of the glows in the south of Europe or in the United States. In Aberdeen, the unusual luminosity was seen within 22 hours after the fall of the meteor, a feature that it is difficult to explain, though the best interpretation, in Dr. Whipple's opinion, is that an air-current travelled over Siberia and northern Europe at a height of about 80 km. with a velocity of 200 km. per hour. The remarkable air-waves recorded by microbarographs at four stations in Great Britain were registered at nine other observatories, the most distant from the origin being Washington (8,910 km.) and also, by way of the antipodes, at Potsdam (34,920 km.). From the Irkutsk seismogram, it is deduced that the meteor fell at 0 h. 14 m. G.M.T. on June 20 at a point in lat. 60° 40′ N., long. 101° 57′ E. In estimating the velocity of the air-waves, the times at which the first trough arrived are used, and it is assumed that the trough started from the above point at 0 h. 16 m. The velocities obtained range between 313 and 322 km. per sec., with an average of 318 km. per sec.

Dielectrics. Parts 2 and 4 of vol. 17B of the *Journal of the Indian Institute of Science* contain communica-

tions from Messrs. Ramaswamy, Narayanaswami and Mowdawalla, of the Indian Institute, on the effects of magnetic fields and successive discharges on the dielectric constants, power factors and breakdown voltages of dielectrics. Solid dielectrics were tested between circular plate electrodes and fluids between spherical electrodes to which alternating electromotive forces up to 115 kilovolts could be applied by a transformer. Magnetic fields up to 18 kilogauss could be produced by a direct current electromagnet. The authors conclude from their measurements that the effects of the magnetic field on dielectric constants and power factors are very small in air and oil, but are appreciable on the power factors of papers and on both dielectric constants and power factors of glass and mica if the magnetic field is transverse to the electric field. The breakdown voltages of air, mineral oils and manilla paper are little affected by fields up to and exceeding 10 kilogauss, but are decreased 3–6 per cent for other papers and increased nearly 2 per cent for glass. Successive discharges up to about a thousand reduce the breakdown strength of dry mineral oils and raise those of moist oils to about 43 kilovolts per cm. and of benzene to about 35 kilovolts per cm.

Quenching of Resonance Radiation. O. S. Duffendack and J. S. Owens have discussed the quenching of mercury resonance radiation by the addition of other gases (*Phys. Rev.*, Sept. 1). The effect of temperature on the quenching was specially studied. A quartz cell containing mercury vapour and the quenching gas was illuminated by a mercury argon glow discharge. This constitutes a simplification of the ordinary technique, since the λ 2537 emission line is so narrow that no secondary resonance lamp is required. The temperature of the quartz cell was varied, the pressure of mercury vapour being held constant. The output of resonance radiation was measured by photographic photometry. The principal interest of the results lies in the temperature variation of the quenching, which allows interpretation in terms of the quenching mechanism. The quenching by hydrogen is practically independent of temperature, the quenching by carbon monoxide and nitrogen decreases with increasing temperature. In the former case, the mercury metastable state $2\ {}^3P_0$ is not involved; in the latter case, the $2\ {}^3P_1$ excited atoms are reduced to the metastable state by gas collisions, and this reverse process goes on with increasing frequency at higher temperatures. A mechanism is suggested for the former (hydrogen) quenching involving the dissociation of the hydrogen molecule, followed in some cases by the excitation of the mercury hydride molecule produced.

X-Ray Examination of Carbohydrate Acetates. The lattices of glucose and cellobiose were established in 1929 by Hengstenberg and Mark, who succeeded in obtaining crystals large enough and perfect enough for complete analysis. Zechmeister and Tóth in 1931 by means of the hydrolysis of cellulose prepared some of the higher cellodextrins, namely, cellohexaose, cellotetraose and cellotriose. G. J. Leuck and H. Mark have now (*J. Amer. Chem. Soc.*, **56**, 1959; 1934) attempted an X-ray examination of some of these higher sugars in the form of acetates, employing in some cases material prepared by Zechmeister and Tóth. The acetate of cellotriose was obtained in suitable crystals, and the acetates of glucose and cellobiose were also investigated. Crystallisation from 96 per cent alcohol was used, and a special technique for orienting the directions of groups of crystals was adopted. Monochromatic rays from copper ($\lambda = 1 \cdot 54$ A.) were used, and the densities determined by flotation in salt solution. The identity periods a, b and c (needle axis) were determined, and the numbers of molecules in the unit cell then calculated. The c values were practically the same, $5 \cdot 65$–$5 \cdot 7$ A. The crystals of glucose penta-acetate are orthorhombic. The numbers of molecules in the unit cell for glucose penta-acetate, cellobiose octa-acetate and cellotriose undeca-acetate are 4, 2 and 2, respectively, only the first value being quite certainly established. The molecular chains in all three substances probably lie perpendicular to the needle axis. The authors make certain suggestions as to the spacings in relation to the cellulose molecule.

Unsaturated Acids in Animal Oils and Fats. It has been believed for many years that the body fats and oils of land animals are composed principally of glycerides of oleic, palmitic and stearic acids. Careful investigations have usually revealed the presence of small amounts of saturated acids of lower molecular weight than palmitic, as well as small amounts of linolic acid, $C_{18}H_{32}O_2$. Linolenic acid, $C_{18}H_{30}O_2$, is rarely found and originates in the diet. Arachidonic acid, $C_{20}H_{32}O_2$, has been found in some fats, and it seems possible that highly unsaturated fatty acids, with four or more double bonds, might occur rather generally in animal fats and oils. J. B. Brown and C. C. Sheldon (*J. Amer. Chem. Soc.*, **56**, 2149; 1934) have examined twelve specimens of fowl oils and four of animal fats by a method depending on the fact that highly unsaturated acids or their methyl esters, on bromination in cold ether, yield characteristic insoluble polybromides. The results showed that linolenic acid was present in some specimens of goose oil and probably in turkey oil. Eight other specimens of avian oils contained small amounts of highly unsaturated acid, mostly arachidonic. The four specimens of animal fats (lamb, veal, reindeer and beef tallows) contained traces of highly unsaturated acids other than arachidonic.

Fermi's Differential Equation. Fermi's differential equation is of considerable importance in atomic physics. (The differential equation is $x^{1/2}\dfrac{d^2y}{dx^2} = y^{3/2}$. A solution is needed such that $y = 1$ when $x = 0$, and $y = 0$ when $x = \infty$.) Unfortunately, no simple general solution can be obtained, and since the equation has a singularity at the origin, it is difficult to apply the usual methods of numerical approximation, so special investigations are necessary. Fermi himself initiated this work, and Sommerfeld has given the asymptotic expansion of certain integrals of the equation. A systematic study of the whole problem, with full analytical rigour and an estimation of the upper limits of the possible errors, has now been made by C. Miranda (Reale Accademia d'Italia, *Memorie della classe di scienze fisiche, matematiche e naturali*, **5**, 1934), at the institute for the applications of the calculus, under the direction of Prof. Picone. The paper explains some general theorems established by the director of the institute, which give solutions of differential equations, valid even at singular points, in the form of rapidly convergent series. These theorems are then applied to Fermi's equation, and the results are given by means of graphs and several pages of numerical tables.

The Scott Polar Research Institute

THE new building of the Scott Polar Research Institute, Cambridge, was opened on November 16 by the Chancellor of the University, Mr. Stanley Baldwin, in the presence of a distinguished company. In a pamphlet distributed at the opening, the history and aims of the Institute are outlined. The Chancellor also made it clear in his speech on Friday that the building has the twofold object of doing honour to the name of a great polar explorer, and being also a centre of information for those yet to come. The building was therefore designed by Sir Herbert Baker with these two objects in view, and has succeeded in attaining both of them.

The history of the Institute is, briefly, as follows. A balance of £12,000 remained after the War from the Mansion House Fund subscribed in 1913 in answer to Capt. Scott's last message. A first grant of £6,000 was made from this fund in 1920 to establish a polar research institute at Cambridge, and in 1925 the whole trust fund was handed over to the University. £6,000 was set aside as a building fund, and the Institute began its work on an income of £300 a year. In 1931, the Pilgrim Trust made a grant of £4,000 to the building fund and later the trustees of the British Museum gave £2,000 for a publication fund. The whole scheme owes its inception and completion to the unremitting labours of Prof. F. Debenham, director of the Institute, who was a member of Scott's last expedition to the Antarctic.

The present building is of three stories, the uppermost an attic floor with dormer windows behind a balustrade. The front door is flanked by two very large windows to the vestibule and is surmounted by a bronze bust of Capt. Scott, executed by Lady Hilton Young. On a frieze which forms part of the upper stone balustrade are the words QUÆSIVIT ARCANA POLI VIDET DEI, an epitaph which is singularly apt for one who sought so diligently the scientific, as well as the geographical, secrets of the Antarctic, and in doing so found a glorious death; an end, which, as Mr. Baldwin pointed out in his speech, was like the failure of Sir Richard Grenville in his last fight, in that it was more lasting than a success.

In the forecourt there is a symbolic statue given by the same artist, to the memory of the five men of the Pole party. It is in the form of a youth standing with head thrown back, and is one of the best of Lady Young's symbolic designs. On the pediment are the words LUX PERPETUA LUCEAT EIS, and indeed a light everlasting will shine on the memory of Dr. Edward Adrian Wilson, Capt. L. E. G. Oates, Lieut. H. R. Bowers, and Petty Officer Edgar Evans, as on that of their leader.

On the keystones over the large windows are symbolic representations of a polar bear and an Emperor penguin feeding its chick, by Mr. Charles Wheeler. For this carving the late Sir Louis Baron gave £100.

The vestibule consists of a chamber with two high domes painted by Mr. MacDonald Gill with maps of the polar regions. These paintings were the gift of an anonymous donor, and attracted a great deal of interest from those who inspected the building at the time of the opening. They are not only topographically correct in a general sense, but also contain a great deal of historical detail in the form of pictures of famous ships, in their proper localities. Below each map is a ring of names of explorers famous for the great discoveries they made and the extent of their additions to the maps encircled by their names.

The ground floor is taken up by a museum of polar equipment, which includes exhibits of both practical and historical interest. Thus sledges, dog-harness, polar clothing, and Eskimo kayaks are in close proximity to relics from the time of Sir Martin Frobisher, including some from the Parry, Franklin and more recent expeditions. The director and his assistant have each a small room on this floor.

On the first floor there are two research rooms and a library, designed with special care by the architect, with oak parquet flooring and oak furnishings. Adjacent to the library is the map room, also carried out in oak; these two rooms will be spacious enough for their purpose for a very long time to come.

The second, or attic, floor has been most ingeniously designed to give a long gallery for the pictorial side of the collections. The walls are panelled with three-ply African mahogany and are hung with water-colours by Dr. E. A. Wilson. Display cupboards, after a design borrowed from Sir Sydney Cockerell of the Fitzwilliam Museum, further increase the space available for hanging sketches and pictures. In cabinets and lockers on this floor are kept the already very large collection of photographs and other illustrations of past expeditions.

The Polar Research Institute would not justify its name were it nothing more than a depository of things polar, and its real activities are possibly not evident to the passing visitor. The first duty of the Institute is to keep in touch with all investigations made in, or concerning, the polar regions. It does this by maintaining a large correspondence with people interested in polar matters in Great Britain and other countries. It is satisfactory to record that an increasing number of the visitors are more or less directly concerned with expeditions going or returning.

A second duty is to provide facilities for those wishing either to organise an expedition or to work out the results of one which has returned. In the past eight years there has been a constant use of these facilities, beginning with the temporary residence of Mr. V. Douglas to work out the geological results of Sir Ernest Shackleton's *Quest* Expedition. The Institute does not organise expeditions itself, nor is it concerned only with those from Great Britain; many of the requests for information come from overseas.

A third activity of growing importance is the publication of the *Polar Record* in January and July of each year. By means of the large correspondence referred to above, by reference to press-cutting volumes which are kept up to date, and with the assistance of many well-wishers, it has become a publication unique in character. Each number consists briefly of a review of all major events in the polar regions for the previous six months, and in addition to this it usually contains an authoritative article on some subject of topical interest. Its circulation is growing rapidly and it has proved a very useful means of spreading interest in the work of the Institute. Nevertheless it is still, owing to scarcity of funds, unable to illustrate its pages with plates and maps in the style the subject merits, nor is the size to which the journal is limited sufficient to include long articles or reviews of books.

Industrial and National Aspects of Technical Education

THE discussion at Aberdeen on September 11 arranged by the Department of Industrial Co-operation of Section F (Economic Science and Statistics) and Section L (Educational Science) of the British Association, on the planning of a national policy of technical education and industrial recruitment, followed very appropriately Mr. H. T. Tizard's presidential address to Section L and a subsequent discussion in that section on the development of post-primary education during the present century. Mr. Tizard had referred particularly to the way in which the lack of co-operation or understanding between some branches of industry and the universities regarding the character of a university training is liable to lead to engineering graduates, for example, finding themselves in blind alleys or to definite unemployment, as among the biologists. While there can be no two opinions about the folly of a policy of encouraging young men of good ability to spend long years in specialised study, only to find at the end that there is no demand for their services or that the posts offer inadequate prospects, this has been the experience of many science graduates during the past fifteen years. If, however, Mr. Tizard's suggestion that the supply should be deliberately kept short of the demand is not altogether acceptable to industry, the alternative is to attempt some definite planning of technical education both quantitatively and qualitatively in relation to industrial recruitment.

The discussion on this question, while exploring a number of important aspects, was rather disappointing as a definite contribution to the solution of the problem. For this the meagre interest taken in the discussion by industry as a whole may have been responsible, in spite of the valuable contributions of Mr. A. P. M. Fleming and Mr. W. Rintoul. The discussion was opened on the administrative side by a paper by Mr. J. W. Bispham, which surveyed particularly the functions of the technical school and also discussed the effect of raising the school-leaving age, which he considers is inevitable in the near future. The emphasis which was laid on the hardship frequently caused to students, as well as the unwise duplication of equipment, etc., through the sectional treatment of technical education where overlapping or contiguous areas are concerned, indicates the need for national planning of educational facilities. Local rivalries or prejudices are above all out of place in determining educational policy. Equally important is a much closer contact between industrial and educational authorities.

Mr. G. W. Thomson's survey of the position of technical education in Scotland was an important contribution from much the same point of view, but laid considerable stress on the social aspects of the problem. These include the relation of technical education to actual employment, and the dangers of exclusive vocational training. A much larger place for the teaching of English in all technical education was claimed, partly because of its cultural value and as a corrective to the narrow stratification of industrial society, but partly also because of its power to encourage the initiative and originality of thought and expression which industrial conditions often tend to repress. Mr. Thomson also directed attention to the neglect of apprenticeship and to the value of closer correlation between educational authorities and those responsible for the conduct of industry in extending the provisions for part-time study in day classes.

This vigorous plea for the consideration of individual needs in the planning of a policy of technical education was supported by Principal J. Cameron Smail, who however differed as to the place of the teaching of English and cultural values, and deprecated the pushing of selected young people at fourteen or fifteen years of age, urging that a watch should be kept on the education of all young people up to the age of eighteen years. The most serious recent criticism of our system of technical education, that it has been planned too much in accordance with demands from below and not enough in response to requirements from above, was, however, scarcely noted in the discussion, even in the important paper by Mr. A. P. M. Fleming which preceded that by Mr. Thomson. This paper gave a comprehensive account of the methods of recruitment and training used by a large centralised industry, employing 10,000 workers, 3,000 of whom are staff grade, including 800 with technical qualifications. A deliberate attempt has been made in co-operation with educational institutions to effect a planned system of co-ordinating supply and demand, having regard to the influence of the trend of development in engineering plant and apparatus, types and methods of production and markets for new as well as for established engineering products. The scheme attempts to place a premium on ability, and to facilitate promotion of those possessing the requisite qualities from the lowest to the highest positions of responsibility.

In the selection of recruits for training, whether at the usual age of fourteen years for a seven-year apprenticeship system, or of the university trained staff, Mr. Fleming said that reliance is placed on the judgment of the trained staff familiar with this work rather than on vocational or intelligence tests. Attention was directed to the value of a year in the works before proceeding to a university, particularly in avoiding the possibility of a misfit, and also to the value of a cross-connexion between industrial and academic research. Curricula, too, need careful planning if the originality of the investigator is not to be suppressed. On the other hand, post-graduate work and travelling scholarships may well be deferred until some industrial experience has been acquired. Many students are unfit from the start for an industrial career, and in view of the careful practical training now given by some large organisations to their scientific staff, Mr. Fleming suggested that such training invites university recognition by the conferring of a higher degree on men who have pursued such a course in an organisation of accepted standing. The award of research scholarships and the like, enabling the recipient to pursue investigations in laboratories where the facilities are often much greater than in a university, is another way in which co-operation between industry and the universities might be extremely fruitful.

Mr. Fleming's outline not merely of actual achievements but also of some of the possibilities of co-ordination and planning in this field was the most important contribution from the industrial side. Mr. W. Rintoul's paper was limited to a discussion of technical education as applied to the training of

chemists for industry. Like Mr. Fleming, Mr. Rintoul laid a good deal of stress upon the training which supplements that given at the university. For the analyst, post-graduate training in general research or in chemical engineering, etc., is desirable. For the chemist in charge of plant, a two-year course in research or in chemical engineering might equally be desirable but it is highly important that this post-graduate training should be obtained in a university other than that in which he qualified, so as to widen his outlook as much as possible. On entering industry, a year or so should be given to analytical work.

Stressing the value of the knowledge acquired outside the university in such post-graduate work, Mr. Rintoul emphasised the continual necessity for the works chemist to keep himself in touch with developments by membership of scientific or industrial societies and attendance at their meetings. The suggestion of special leave for selected men for a refresher course after five years' service or more was akin to suggestions made by Mr. Fleming. Equally for the research chemist, Mr. Rintoul urged that post-graduate training should be carried out in a fresh university on account of the wider technique and experience thus acquired, as well as the greater stimulus given to originality by a change of environment. The training of the chemist for definitely commercial work is probably best completed after entering industry itself.

In most of the papers and in the discussion, full attention was directed to the social aspects involved in planning technical education and particularly the problems raised by mechanisation. Apart, however, from a very demonstrable consciousness that technical education must be regarded as a vital national matter and not a purely local one or the concern of industries by themselves, the discussion made little definite contribution to immediate progress, and the valuable suggestions made from the industrial side scarcely attracted the attention they deserved. None the less, the discussion of this subject at a British Association meeting should at least assist the formulation of a definite and adequate policy in which technical education is treated not as a thing apart, but in relation to those wide issues of juvenile unemployment, industrial efficiency and the raising of the school leaving age from which it cannot be divorced without danger to the community.

The Sanriku (Japan) Earthquake Seawaves of 1933

THE great earthquake that gave rise to these destructive seawaves occurred on March 3, 1933. As soon as the news of the disaster reached Tokyo, several members of the Earthquake Research Institute were sent to the districts principally affected. The chief points that they investigated were the highest levels reached by the *tunami* or seawaves, the areas of the regions inundated, the damage to houses, etc., and the relations between the effects of the waves and topographical conditions.

Several memoirs have already appeared and an abstract of one of them, by Messrs. Imamura and Kawase (NATURE, 133, 72–73; 1934), gives the main facts as regards the height of the waves and the loss of life and property. In March of the present year, or about a year after the earthquake, the reports of the observers have been published. They occupy a whole volume (Supplementary Vol. I) of the *Bulletin* of the Earthquake Research Institute. To have produced in so short a time a work of such value and interest, accompanied by such wealth of illustration, is a remarkable feat and one for which seismologists can scarcely be too grateful. The volume contains 521 pages and 251 plates. The first half consists of sixteen memoirs, thirteen of which are written in English and the rest in Japanese with abstracts in English. The second half contains the reports of the observers, which, except for a brief abstract of two pages and the titles of the plates, are written entirely in Japanese.

Besides these investigations, experiments are being made in the Institute laboratory in which, by means of models, the natural conditions are imitated as far as possible. They are still unfinished, but the final results, which will be published shortly by the Institute, can scarcely fail to throw light on the nature of earthquake seawaves.

The tide-tables show that the sea at the time of the earthquake was practically at mean sea-level. The heights reached by the waves were determined from the marks left by them on houses, trees and cliffs. As a rule, the heights reached in 1933 were slightly less than those in 1896, but some of them were considerable, the greatest being 94 ft. at Sirahama in Ryôri.

The propagation of the seawaves is studied by Prof. N. Miyabe (pp. 112–126). They were recorded by mareographs at eighteen stations in Japan, only one of which lies on the Japan Sea side. Unfortunately, the times at which the first waves arrived cannot always be determined with precision, and there may be errors of as much as five minutes in the estimates. Taking their probable values and using the formula $v = \sqrt{(gh)}$, Prof. Miyabe has drawn circles with the stations as centres, and radii equal to the distances the waves would travel in the intervals between the time of the earthquake and the times of arrival at the respective stations. These circles do not intersect in a point, but envelop one side of an area about 600 km. in length from north to south. Thus, it is possible that the displacement that gave rise to the seawaves may have been several hundred miles in length. The seawaves were also recorded by mareographs at Honolulu, San Francisco and Santa Monica (Cal.). The mareograms at Manila and Wellington (N.Z.) show no trace of the waves, perhaps on account of the disturbing effect of intermediate islands. Nor do those at Sydney and Melbourne record them with certainty. On the other hand, they are shown with considerable amplitude at Iquique in Chile, though that station is nearly 9,000 miles from the origin.

Mr. K. Musya describes in great detail the luminous phenomena observed with the seawaves (pp. 87–111). He classifies them according to the following types: the crest of the waves emitted dim continuous light (for Prof. Terada's explanation of this light, see NATURE, 133, 73; 1934); the surface of the sea glittered all over; the waves on the shore-line gave out bluish light; when the sea-water receded before the arrival of the great waves, the exposed sea-bed gave out blue light; a luminescent body like a meteor was seen; well-defined round luminous bodies were seen in an incoming wave; a round-shaped luminous body appeared above the sea; and bright light radiated from the sea.

C. DAVISON.

University and Educational Intelligence

CAMBRIDGE.—H. J. Bhabha, of Gonville and Caius College, has been elected to an Isaac Newton studentship, and C. G. Pendse, of Downing College, to an additional Isaac Newton studentship.

Applications for a John Lucas Walker studentship are invited and should be sent before December 1 to Prof. H. R. Dean at the Department of Pathology, to whom requests for further information regarding the Studentship may be addressed. This studentship will be tenable for such period and will be of such annual value not exceeding £200 as the professor of pathology with the approval of the managers may determine.

LONDON.—The Essex County Council has decided to make a grant of £33,000, payable over ten years, towards the erection of the new University buildings The Worshipful Company of Tallow Chandlers has made a donation towards the Ceremonial Hall to be built on the Bloomsbury site.

OXFORD.—On November 17, Dr. R. T. Gunther delivered a public lecture on contributions to science by early members of Balliol College. Names specially mentioned by him were John Evelyn, an early fellow of the Royal Society, and James Bradley, the discoverer of aberration and the first observer of lunar nutation. A tribute was paid to the memory of Henry Smith, a man of wide attainments and a really great mathematician, whose fame with the outside world fell far short of his actual abilities.

SHEFFIELD.—The following appointments have recently been made: Mr. A. J. Holland, to the Society of Glass Technology Research fellowship; Mr. Norman E. Densem, to a research fellowship in the Department of Glass Technology.

The Council has accepted an offer from the Society of Glass Technology of a research fellowship for a period of two years, of the value of £200 per annum.

THE American Association of Dental Schools, stimulated by the publication in 1926 of Dr. W. J. Gies's report to the Carnegie Foundation for the Advancement of Teaching on "Dental Education in the United States and Canada", appointed some three years ago a curriculum survey committee, and has lately adopted a series of recommendations presented by this committee at the Association's annual meeting held this year in Chicago. The recommendations have been published in an article by the committee's secretary in *School and Society* of August 18. They are in accordance with a tendency, said to be increasingly manifested in the United States, to regard dentistry as a health service, and they aim at giving effect to Dr. Gies's contention that the practice of dentistry "should be developed into the equivalent of an oral specialty of the practice of medicine". The objectives of the curriculum are declared to include competence in the "maintenance of oral health and the treatment of oral diseases . . . with understanding and appreciation of the relationships between oral and systematic conditions in health and disease". Two years of education in the liberal arts and sciences are to be required for admission to the dental school, which is to provide a four-year professional course. Having dealt with the subject of the undergraduate curriculum, the committee is proceeding to study methods of teaching, graduate instruction and the education of dental teachers, research workers and specialists.

Science News a Century Ago

Death of Johann Tobias Burg

On November 25, 1834, Johann Tobias Burg, the Austrian astronomer, died near Klagenfurt. Born in Vienna on December 24, 1766, Burg was educated under the Jesuits, and at an early age was admitted to the observatory at Vienna. In 1791, he was sent as a teacher to Klagenfurt, but in the following year, on the death of Hell, returned to the observatory. In 1798, the Institut de France offered a prize for the determination of the mean places of the apogee and ascending node of the lunar orbit, by means of at least 500 observations. Burg applied himself to this laborious task, employing no fewer than 3,232 observations in his calculations. Bouvard was his only competitor, and the judges, Lagrange, Laplace, Delambre, Legendre and Mechain divided the prize, awarding two thirds to Burg. Napoleon, however, aware of the importance of the work, doubled the value of the prize; while the Emperor of Austria decorated Burg with the Cross of Leopold. Burg continued to devote his attention to the study of the motion of the moon, publishing his results at Vienna and Berlin. Becoming deaf, he retired to a house in the country at Wiesena near Klagenfurt, where he died at the age of sixty-seven years.

Almanacs for 1935

The first almanac printed in England appeared in 1497. The almanac of Francis Moore (1657–1715 ?) dates from about 1700, the "Lady's Diary" appeared in 1705, the "Gentleman's Diary" in 1741 and the "Nautical Almanac" in 1767. A stamp duty had been imposed on almanacs in 1710, but this was abolished in August 1834, and in consequence of this there was a great increase in the number of almanacs published. The *Mechanics' Magazine* of November 29, 1834, devoted considerable space to a review of the many published almanacs for 1835, which were "mostly of such a quality as to be dear at any price". The "People's Almanac", the "British Diamond Almanac", the "British Calendar and Almanac" and "Marshall's Penny Almanac" all abounded in more or less inexcusable blunders. The writer of the article did not think people put so great a faith in "Partridge's Almanac" as that of Francis Moore, who with all his "old-fashioned nonsense continues to display an ardent devotion to all the best interests of humanity". The "Lady's" and "Gentleman's Diaries"—"old friends with new faces"—had original contributions to mathematical science, that in the "Gentleman's Diary" being a long and able article by W. S. B. Woolhouse "on the Fundamental Principles of the Differential and Integral Calculus and the Reasonings employed in their Application". Mr. Woolhouse, it was said, had presented the principles of the calculus "in as intelligible and popular form as possible and has succeeded to a degree which we scarcely imagined within the limits of attainment".

Societies and Academies

LONDON

Royal Society, November 15. A. R. MEETHAM and G. M. B. DOBSON: The vertical distribution of atmospheric ozone in high latitudes. Observations to determine the vertical distribution of the ozone in the atmosphere—similar to those recently made at Arosa—were carried out at Tromsø in May and June, 1934. They show that the average height of the ozone is very slightly lower at the higher latitude and indicate that at Tromsø the ozone is more concentrated in a region centred at a height of 21 km. above sea-level, whereas in Switzerland it is more uniformly distributed through the lower 30 km. of atmosphere. G. G. SHERRATT and E. GRIFFITHS: The determination of the specific heat of gases at high temperatures by the sound velocity method. The experiments recorded carry the determination of the specific heat of carbon monoxide by this method up to a temperature of 1800° C. By working with more than one frequency and correcting the data for the effect of frequency on the velocity of sound in the gas, the specific heat in the temperature range 1000°–1800° C. is found to be in good agreement with that deduced from spectroscopic data. Specific heats based on sound velocity measurements in various gases have not hitherto been found to be in accord, even at moderately high temperatures, with those obtained from spectroscopic data. The discrepancy is probably due to the use of a single frequency, for it is now known from practical and theoretical considerations that the velocity of sound in a gas is not necessarily independent of the frequency.

PARIS

Academy of Sciences, October 22 (*C.R.*, 199, 745–811). The president announced the deaths of Francis Gonnesiat, *Correspondant* for the Section of Astronomy, and of Santiago Ramon y Cajal, *Correspondant* for the Section of Anatomy and Zoology. ERNEST ESCLANGON: Notice on the work of F. Gonnessiat. MAURICE CAULLERY: Notice on the work of Santiago Ramon y Cajal. JULES DRACH: The logical integration of the equations of dynamics: central forces. JEAN TILHO: The possibility of the capture of the Logone, a tributary of Lake Tchad, by the Niger. The dangerous consequences to Tchad and the neighbouring regions of such a change of course of the River Logone are pointed out, and a comparison is made with the change of course of the River Mahajamba, in Madagascar, which occurred in February 1903. Possible precautionary measures are discussed. ANDRÉ BLONDEL: The utilisation of yellow glasses in the technique of lighthouses or aviation beacons. In spite of a reduction in the range, the use of yellow glasses has certain advantages for lighthouses, especially those in use at the entrances to ports. PAUL MONTEL: Some new limitations of the moduli of zeros of polynomials. H. EYRAUD: Some laws of errors analogous with systematic errors. SERGE FINIKOFF: The transformation of surfaces with the aid of ∞^2 quadrics having a contact of the second order with the surface and its transform. G. PÓLYA: The application of linear differential operations to series. GH. TH. GHEORGHIU: Metaspherical functions. CHARLES PLATRIER: The ballistic problem of Lagrange: the first median zone. JEAN MASCART: The grouping of the planetary perihelia. BERNARD LYOT: The polarisation of the minor planets. A new photographic method is described, giving results of much higher accuracy than is usual in photographic photometry. MLLES. RENÉE CANAVAGGIA and MARIE LOUISE FRIBOURG: The differential rotation of the currents of Ursa Major, Taurus and Scorpio. JEAN LOUIS DESTOUCHES: The axiomatic in the theory of photons of Louis de Broglie and superquantification. GASTON DUPOUY and CHARLES HAENNY: A new method of absolute measurement of the magnetisation coefficients and the magnetic susceptibilities of liquids. A modification of the Gouy cylinder method. A quartz rod is suspended in the liquid the magnetic properties of which are to be measured. The apparent susceptibility of the rod with respect to the liquid is determined, utilising the change of weight of the suspended rod; the susceptibility of the rod is determined separately and that of the liquid calculated. With a magnetic field of about 30,000 gauss and for solutions with a coefficient of magnetisation of the order of 10^{-5}, the force to be measured is more than 1 gm. and coefficients of magnetisation of the order of 10^{-9} can be determined. JEAN GENARD: The magnetic extinction of the fluorescence of the diatomic molecules of selenium. PIERRE AUGER and LOUIS LEPRINCE-RINGUET: The analysis of the cosmic radiation at high altitudes. Research carried out at the International Laboratory on the Jungfraujoch. JEAN AMIEL: Moist mixtures of chlorates and sulphur and some other reactions of moist chlorates. ALBERT PORTEVIN and E. HERZOG: Some conditions to be realised in tests on the corrosion of steels in a moist medium. Discussion of the causes of the difficulty in obtaining concordant measurements of corrosion. PIERRE CARRÉ and DAVID LIBERMANN: The preparation of veratryl chloride and the formation of the 9, 10-dihydroanthracene nucleus. OCTAVE BAILLY and JACQUES GAUMÉ: The migration of the phosphoric acid radical in the course of the hydrolysis of β-methylglycerophosphoric ester. The passage from the β- to the α-glycerophosphates. HENRY GAULT and JEAN BURKHARD: Ketolic condensations of acetoacetic ester with formaldehyde. GEORGES DEFLANDRE: The presence of conifer pollen (Abietineæ) in a flint from the chalk. Showers of pollen in the Cretaceous period. MAURICE QUENDIAC: A condition of the accumulation of tannin-bearing cells in chestnut wood. GUSTAVE GUITTONNEAU and RENÉ CHEVALIER: The calcophosphoric equilibria realised in cheeses. ADOLPHE LEPAPE and RENÉ TRANNOY: The fixation by plants of radium available to them in the soil. LUCIEN CHOPARD: The presence of a spermatophore in certain Orthoptera of the family of Phasmids. RAOUL M. MAY: The subcutaneous brephoplastic graft of the thyroid in the rat. MME. MARIE PHISALIX: The natural immunity of the hedgehog towards bee venom.

CRACOW

Polish Academy of Science and Letters, October 8. S. ZAREMBA: A general theorem relating to partial differential equations of the second order, linear and of the hyperbolic type. S. PIOTROWSKI: The variable stars 355, 1933 Herculis and 354, 1933 Ophiuchi. The elements of these stars have been determined from 67 observations of 355 and 59 of 354. W. JACYNA: Theorem of the preliminary choice of the arbitrary functions in the equation of state in thermodynamics. W. JACYNA, J. DEREWJAKIN, A. OBNORSKY

and T. PARFENTJEW: The equation of state of helium in the medium region of temperature. N. N. MALOV: The influence of the wave-length of high-frequency electric fields on their mortal action. Remarks on a recent communication of W. Szymanowski on the same subject. K. DZIEWONSKI: A simplified method of mercurisation and degradation of the polycarboxylic aromatic acids. When the acids or their anhydrides are heated with mercuric oxide and water at 150°–180° C. under a pressure of 10–15 atmospheres, one carboxyl group is removed; at higher temperatures (200° C.) all the carboxyl groups are removed. K. DZIEWONSKI and CZ. DRAGAN: A new method of synthesis of compounds of the type of the 1-alkyl-2-hydroxynaphthalenes. K. WODZICKI: The presence of the right oviduct in the domestic duck. The author proves that a Müllerian duct appears in 90 per cent of the domestic ducks examined. J. ZACWILICHOWSKI: Researches on the innervation and the sensorial organs of the wing of *Tipula paludosa*. R. J. WOJTUSIAK: The faculty in the tortoise of distinguishing form, direction and dimensions of an object.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 3). A. MARKOV: Isotopy of compact entities in Euclidian spaces. N. MUSCHELISHVILI: New problem in the theory of elasticity. P. NOVIKOV: The separability of analytic entities. B. GERASIMOVITCH: The absolute magnitude of *Be*-stars. G. KRUTKOV: A special case of Brownian rotation movement. D. PANOV: The approximate determination of the centre of flexure for a symmetrical section. A. BELIAJEV and J. CHARITON: Transmission of detonations in a vacuum. N. ZELINSKIJ: Transformation of pentamethylene cycles with broken ring into the carbohydrates of the paraffin series by contact with platinum in the presence of hydrogen. P. LAZAREV and A. GAMBURCEVA: Variations in the peripheral visual adaptation during eight months. P. LAZAREV and A. DUBINSKAJA: Changes in the visual adaptation caused by cerebral disturbance. S. GAMBURCEVA: A graphical method for studying the curves of adaptation in peripheral vision. M. LOBASHOV and F. SMIRNOV: The nature of the action of chemical agents on mutational process in *Drosophila melanogaster*. (2) The effect of ammonia on the occurrence of lethal translocations of genes. H. FRIESEN: Further investigations on the artificial production of crossing-over in the males of *Drosophila*. D. SCHWARTZ: Hypertetraploid tobacco resulting from interspecific hybridisation. K. MIRIMANIAN: Congelation in Armenia. A. EBERZIN: Age of the conglomerates of Cape Pitzunda (Caucasus). A. FORMOZOV: Competition between species. Mutual relations between the squirrel (*Sciurus vulgaris*, L.), the crossbill (*Loxia curvirostra*, L.) and the great spotted woodpecker (*Dryobates major*, L.). N. NASONOV: The formation of cartilage *in vitro* in the axolotl.

ROME

Royal National Academy of the Lincei, June 17. F. SEVERI: The rational involutions on a surface as equivalence series: their virtual Jacobian groups (2). G. ABETTI: The variability of the period of rotation of the sun. The relatively high values obtained prior to 1912 by the spectroscopic method for the velocity of rotation of the sun are probably subject to systematic error. Since then, the variations in the results have been small (1·93–1·97 kilometres per second for the linear velocity at the equator) and might easily be caused by accidental or systematic error in the observations. L. LOMBARDI and E. BOTTANI: Investigations on the distribution of the continuous current in a homogeneous conductor subjected to the influence of a permanent magnetic field (2). The experiments described were made with the object of testing Weber's discovery of the non-uniform distribution of continuous current in a homogeneous conductor in a magnetic field. The results obtained support the theoretical considerations advanced in the authors' earlier note, and indicate that, apart from small deformations which the internal equipotential surfaces and the lines of current may undergo as a result of the Hall effect, Weber's phenomenon is non-existent. C. SEVERINI: Double series of orthogonal and normal functions (1). L. TOSCANO: The integration of recurrent linear and homogeneous successions of the second order (1). E. BORTOLOTTI: General views on Vitali's calculus and its extensions (2). L. CAMPEDELLI: Further considerations on the calculation of the Zeuthen-Segre invariant for an algebraic surface. P. LIBOIS: A class of quadruple planes. M. RENATA FABBRI: Poinsot's cones in a particular rotation of heavy solids. G. GARGIA: Laws of Einsteinian planetary movement. GIULIO BEMPORAD: Variations of the eccentricity in the orbits of binary systems. D. FAGGIANI: The time of circonsonance (acoustic reverberation) in chambers with apertures. D. GIGANTE: The limit of resistance of the pigeon to insulin. Under normal conditions the pigeon is endowed with an insulin resistance higher than that of any other bird yet examined.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 461–494, Aug. 15, 1934). A. M. SKELLETT: Proposal of a method of observing the solar corona without an eclipse. The scanning disc technique of television is suggested. The image of the sky around the sun's disc might be scanned in a spiral path round the sun starting from a limb, and the resultant current from a photoelectric cell passed through electrical filters to eliminate the direct current component (due to skylight and telescope glare) and the low frequency components (due to radial progression), leaving high frequency components due to corona and 'poor seeing'. The image re-constructed from the filtered current would show the corona without skylight glare and could be observed directly or photographically. The method has been tested in the laboratory. CLYDE E. KEELER and W. E. CASTLE: The influence of pregnancy upon the titre of immune (blood-group) antibodies in the rabbit. The titre falls during pregnancy and rises sharply after parturition. It is possibly caused by absorption by the embryo of some substance in the maternal blood necessary for the production of antibodies. M. STANLEY LIVINGSTON, MALCOLM C. HENDERSON and ERNEST O. LAWRENCE: Radioactivity artificially induced by neutron bombardment. Following up Fermi's results, various elements were submitted to a stream of neutrons produced by exposing them to beryllium bombarded by deutons. The induced activity of calcium fluoride has a half-life of about 10 sec. Silver seems to show two decay periods of half-life 154 ± 10 sec. and 26 ± 4 sec. respectively, possibly connected with the

presence of two silver isotopes. For aluminium the decay period is $9 \cdot 5 \pm 0 \cdot 5$ min. and for copper about 7 min. The observed radiations in each case are of electronic mass and for silver and aluminium are electrons. Estimates have been made of the activity induced by a given number of neutrons and of the energy of the radiation emitted. CHARLES HAIG: The spectral sensibility of *Avena*. The bases and tips of young oat shoots respectively were exposed to monochromatic light. The tip responses show a maximum at λ 4800; base responses show no maximum in the visible spectrum but possibly one in the ultra-violet. This confirms the earlier suggestion of separate photoreceptor systems. FOLKE SKOOG and KENNETH V. THIMANN: Further experiments on the inhibition of the development of lateral buds by growth hormone. The view that this inhibition is due to high concentration of growth hormone preventing its production by a given tissue is re-stated. Inhibition is complete without increase in stem length or thickness. Further, crystalline preparations of growth substance are as effective for decapitated pea plants as natural preparations of the same concentration of growth substance, showing that impurities are not involved. ALFRED J. MARIA: The potential of a positive mass and the weight function of Wiener. NATHAN KAPLAN: V_3 in R_6.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, November 25

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. C. Hinton: "Some Fossil and Living Mammals".*

Monday, November 26

BRITISH MUSEUM (NATURAL HISTORY), at 5.30—(at Imperial College of Science, Exhibition Road, South Kensington, London, S.W.7).—Dr. R. M. Craig: "The Geology and Scenery of the Hebrides" (Swiney Lectures on Geology. Succeeding lectures on November 28, 30, December 3, 5, 7, 10, 12, 14, 17, 19 and 21).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Ivan T. Sanderson: "The Mamfe Basin, Cameroons".

Wednesday, November 28

BRITISH SCIENCE GUILD, at 4.30—(at the Goldsmith's Hall, Foster Lane, London, E.C.2).—Prof. J. B. S. Haldane: "Human Biology and its Applications" (Norman Lockyer Lecture).

Friday, November 30

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.30—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—A. Keiller: "Excavations (1934) on the Course of the Megalithic Avenue leading from Overton Hill to Avebury, Wilts., commonly known as the West Kennet Avenue".*

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—L. St. L. Pendred: "A Survey of Ships and Engines" (Thomas Lowe Gray Lecture).

ARMOURERS AND BRASIERS' COMPANY, at 8—(at the Royal School of Mines, South Kensington, S.W.7).—Prof. F. C. Thompson: "The Deformation of Metals" (succeeding lectures on December 7 and 14).*

ROYAL INSTITUTION, at 9.—Sir Josiah Stamp: "The Roosevelt Plan".

Official Publications Received

GREAT BRITAIN AND IRELAND

Technical Publications of the International Tin Research and Development Council. Series A, No. 2: Tin-Iron Alloy in Tinplate, with Notes on some Imperfections. By W. E. Hoare. Pp. 253–264. (London: International Tin Research and Development Council.)

Medical Research Council. Special Report Series, No. 197: Medical Uses of Radium—Summary of Reports from Research Centres for 1933. Pp. 40. (London: H.M. Stationery Office.) 9*d*. net.

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1933. Survey prepared by B. P. Uvarov. Pp. 66. (London: H.M. Stationery Office.) 2*s*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1454 (Ae. Tech. 606): Interferometer for Recording Turbulent Flow. By L. F. G. Simmons and C. Salter. Pp. 3+4 plates. 9*d*. net. No. 1597 (T. 3451c, part): Pressure Exploration over an Aerofoil that completely spans a Wind Tunnel. By W. L. Cowley and G. A. McMillan. Pp. 13+3 plates. 9*d*. net. (London: H.M. Stationery Office.)

The Zoological Society of Scotland. Popular Official Guide to the Scottish Zoological Park. By T. H. Gillespie. Tenth edition. Pp. 116. (Edinburgh.) 1*s*.

The Coventry Libraries. Report of the Committee on the Year's Work, together with the Fourth Annual Report of the Museum for the Year ended 31st March 1934. Pp. ii+30. (Coventry: Gulson (Central) Library.)

The Imperial Forestry Institute: University of Oxford. Tenth Annual Report, 1933–1934, and Prospectus. Pp. 36. (Oxford.)

County Council of the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1934. Pp. 38. (Wakefield: County Hall.)

Board of Education: Science Museum. Rubber Exhibition (November 1934–April 1935): a Brief Account of the History of Rubber from its Source to the Finished Product, and a Descriptive Catalogue of the Exhibits. Compiled by the Rubber Growers' Association. Pp. 44+4 plates. (London: H.M. Stationery Office.) 6*d*. net.

Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the period July 1931–30th September 1933. (Cmd. 4718.) Pp. v+205. (London: H.M. Stationery Office.) 3*s*. net.

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Eleventh Conference held at Somerville College, Oxford, September 21st to 24th, 1934. Pp. 109. (London: Association of Special Libraries and Information Bureaux.) 5*s*.

East African Agricultural Research Station, Amani. Sixth Annual Report, 1933–34. Pp. 48. (London: H.M. Stationery Office.) 1*s*. net.

Hastings Natural History Society. Report and Balance Sheet for the Session 1933–34, Council, Rules and New Members. Pp. 8. (St. Leonards: Hon. Secretary, 23 Charles Road.)

OTHER COUNTRIES

U.S. Department of Agriculture. Miscellaneous Publication No. 192: A Review of the Patents and Literature on the Manufacture of Potassium Nitrate with Notes on its Occurrence and Uses. By Colin W. Whittaker and Frank O. Lundstrom. Pp. 54. 5 cents. Circular No. 320: Report on a Preliminary Field Survey of the so-called "Alkali Disease" of Livestock. By Kurt W. Franke, T. D. Rice, A. G. Johnson and H. W. Schoening. Pp. 10. 5 cents. (Washington, D.C.: Government Printing Office.)

Ministero dei Lavori pubblici, Consiglio Superiore: Servizio Idrografico. Le precipitazioni atmosferiche in Italia, nel decennio 1921–1930. Per Prof. Filippo Eredia. (Pubblicazione N. 16.) Pp. xiv+320+31 plates. (Roma: Istituto Poligrafico della Stato.) 50 lire.

International Institute of Agriculture. Coffee in 1931 and 1932: Economic and Technical Aspects. Pp. 231. (Rome: International Institute of Agriculture.) 20 lire.

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NATURE

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CONTENTS

A Psychiatrist on Religion

SOME years ago a distinguished anthropologist observed, with regard to the conflict between religion and science, that the battle had scarcely begun ; the anthropologists were just getting their guns into position. He might have added that their allies—the psychologists—were also just preparing to take off with a heavy load of bombs to support the artillery.

Dr. David Forsyth's recent presidential address delivered before the Psychiatry Section of the Royal Society of Medicine must certainly be regarded as an able and disturbing contribution to this offensive. The explosives utilised were of the recognised Freudian type. For example, inasmuch as remarkable likenesses exist between certain religious ritual practices and the behaviour of sufferers from obsessional neurosis, we may conclude that "the private obsessional neurosis is a private religious system, and religion a universal obsessional neurosis". Conscience, too, consists of latent memory of parental injunctions and prohibitions. The adult idea of God "has originated in the earlier idea of the father, of which it is an abstracted and elaborated repetition". With regard to guilt, "The original guilty feelings seem to arise from conflict between the child's inclinations and its parents' wishes . . . and from the child's contending emotions towards its parents—its love of the one and jealousy and hate of the other". In prayer and contemplation "the worshipper withdraws into himself, shuts out his sensory perceptions and gives himself over to rumination in an auto-suggestive state". The belief in a soul "has no other origin than the experience of dream".

With regard to religious conversion, which is essentially a phenomenon of adolescence, "psychologically the phenomenon is none other than the new strong tide of sexual feeling that accompanies puberty being checked in its usual course and deflected into religion. The check comes from an undue sense of guilt about sexual matters". Sexual deprivation and religious adoration too are closely connected ; "it is inevitable that the unsatisfied erotic feelings should find expression in some 'non-carnal' direction". Even the theological doctrine of the Holy Trinity may be traced to the fact that "a child throughout its earliest and most impressionable years is influenced almost exclusively by two individuals only—its parents. . . . Its earliest conception of human-kind must surely

be as consisting of its father, its mother and itself. Here is the first experience of a trinity".

Such contentions, and many others of the same sort, cannot but be extremely damaging to religion, if they are valid. Far more damaging, however, is the Freudian contention that religion is seriously inimical to mental health and well-being. That a distinguished British psychiatrist should have been led by his practical experience to support this contention ought to lead the exponents of religion to reflect seriously over their policy in certain respects. To quote Dr. Forsyth:

"In the last 25 years we have learned more about the working of the human mind than in the previous 2000, and our psychological methods of treatment have no more in common with the spiritual methods of religion, than modern medical science with the cure of bodily disease by exorcism and prayer.

"If there is one consideration more than any other which confirms this it is in the attitude of the Churches to sex. I believe I am voicing the opinion of the large majority of medical psychologists in saying that of all the causes of mental illness easily the commonest lies in the sexual life. Go about in this country and you will find homes innumerable containing middle-aged nervous invalids, men as well as women, who owe their plight to having been brought up according to the prudish ideas current in their childhood. These ideas survive in the Churches to-day."

Although economic and social as well as religious causes contribute to sex starvation or perversion (it is middle-class families which suffer most—Mr. Barrett of Wimpole Street is still functioning), yet there is no denying that the Church has a bad record in this respect. The trouble is that the Church starts from the principle that there is something 'unclean' about sex, besides being dogmatically committed to certain applications of that principle in the sphere of ethics. Indubitably, owing to the fact that Nature has wished to run no risks about the reproduction of the race, sex is a powerful force, only to be controlled with difficulty. But that is a pressing reason for trying to understand it and deal with it rationally, and not for dogmatising about it and meeting all proposals with a flat *non possumus*.

There can be no doubt that the new psychology is distressing to many people. But the fact has to be faced that we can now no more go behind Freud than we can go behind Newton or Darwin. Theories of gravitation or of evolution doubtless have to be modified, but the principles stand; and so with the theory of the subconscious. What Freudians do sometimes overlook is that their dialectic is an ambiguous weapon and can be used against other activities besides religion. For example, Dr. Forsyth notes how Freud discovers a close parallel (as was indicated above) between religious practices and the behaviour of patients with some obsessional neurosis. But could not many of the practices of the laboratory be attributed in like manner to some morbid curiosity-complex of the 'peeping-Tom' type, especially if the laboratory were a physiological one? Again, there is plenty of evidence adduced by the Freudians for the existence of sadistic and masochistic practices in religion. But could not the practice of vivisection be attributed to a repressed sadistic instinct? Also, might not the neurologists, bacteriologists and physiologists who have not hesitated to experiment upon themselves in the course of their researches, be branded as morbid masochists? To the man of science this interpretation of his behaviour would seem unreasonable, but the closely parallel interpretations of the Freudians seem equally absurd to the sincere religionist.

The truth seems to be that inasmuch as all human activities, scientific and artistic as well as religious, are in the short or long run expressions of the *libido*, all of them are subject to Freudian interpretations. This does not mean that the Freudian dialectic is invalid, but only that it fails to give a complete account of the activities which it sets out to explain, and may thus evacuate them of much of their real value Religion, connected as it is so closely with sexuality (primitive religions being fertility cults), is liable to suffer more from Freudian analysis than either art or science—though art comes off worse than science owing to its connexion with religion and magic.

In another respect, too, religion is less fortunate than either science or art. In discussing it, metaphysical issues can scarcely be avoided. The man of science is more fortunate. He can assume that the entities with which he deals, whether forces, or objects, or organic and mental processes, are real without having to define in what sense they are real, for the simple reason that they seem real to the uncritical perceptions of the general public. What is more, he can brand as unreal whatever eludes his measuring instrument for the time being, and be sure of public support in so doing. Along these lines it is not difficult to represent religion as concerned with fantasy,

and science with reality. The scientific point of view (regarding the world we know by sensory perception as reality) can be represented as the awakening of the mature mind from that confused state of infant mentality when the subjective and the objective are in a state of total confusion. For example, Dr. Forsyth quotes from an article contributed by him to the *British Journal of Psychology* for 1921:

"Where the pleasure principle dominates and psychic truth is accepted as the standard, interest passes to elemental psychical processes, and thence to the supernatural and spiritual; this is exemplified in the evolution of religion and of personal religious faith. Alternatively, with objective reality as the aim, chief importance is given to the facts of the physical and material world, and thence to natural laws; along this line come science and an interest in science."

The only evidence, however, given to show that the 'pleasure principle' and not the 'reality principle' is dominant in religion is that in the case of very young children and neurotics this is the case. But not all religion is immature infantilism or neurotic fantasy. It has been taken for granted, but not proved, that 'objective reality' cannot be the aim of religion, but can only be the aim of science. As a matter of fact, the critical study of scientific method (apart from all questions of metaphysics and the criticism of the 'objective reality' of sensory experience), suggests that the 'truth' of science is largely abstract in its nature, and that the concrete richness of reality escapes the scientific net. This does not discredit science, of course, but suggests that there are areas of objective reality which elude it.

The public, however, general as well as scientific, is placed under a considerable obligation by the writer of such a paper as we have tried to examine. Too rarely does the medical profession lift that veil of reticence where certain important matters are concerned. But with regard to the psychotherapist's general attitude, is it inevitable that he should regard all religion, good as well as bad, as pathological? This appears to be an extreme point of view. Experience teaches that a good religion has a sanitary and stimulating effect, banishing worries and achieving that inner harmony which is the foundation of mental and moral health. What most of the neurotics need is not less religion, but more, provided always that it is of the right kind. J. C. HARDWICK.

Crystal Chemistry

Kristallchemie der anorganischen Verbindungen. Dargestellt von M. C. Neuburger. (Sammlung chemischer und chemisch-technischer Vorträge, begründet von F. B. Ahrens, herausgegeben von Prof. Dr. H. Grossmann, Neue Folge, Heft 17.) Pp. 115. (Stuttgart: Ferdinand Enke, 1933.) 9.70 gold marks.

THIS monograph has been written in order to bring to the notice of a wider circle of readers the work of G. N. Goldschmidt, as set out mainly in publications by the Norwegian Academy. His work on ionic radii, which occupies about sixty pages of the present monograph, is already familiar to English readers, since it formed the subject of a lecture to the Faraday Society in 1929. The ingenious application whereby the crystal properties of zinc silicate, Zn_2SiO_4, as willemite were imitated in the soluble salt Li_2BeF_4 are also familiar to English readers.

One example of the principles involved may, however, be cited as an illustration. According to Goldschmidt, the type of lattice developed by an ionic aggregate AB depends on the ratio of the ionic radii $r_A : r_B$ of the ions A and B. Thus, if this ratio is 0·15 or less, the ion A can be stowed away on the interstices of an equilateral triangle formed by the larger ions B; if the ratio is 0·22, it can be accommodated in a tetrahedron; if 0·41, in a square or in an octahedron, as in rock salt; if 0·73, in a cube as in cæsium chloride. The formation of layer lattices in crystals of the type AB_2 is also determined by the ratio of the ionic radii. Thus, when this ratio is less than 0·73, the metallic ions A can be sandwiched between twin layers of the ion B, giving rise to crystals which have very little cohesion between successive sandwiches. If, however, the ratio is greater than 0·73, an ordinary ionic lattice of the fluorspar type may be developed. Thus $NiCl_2$ forms layer lattices, just like $CdCl_2$, since the ratio of the ionic radii is only 0·43; but $[Ni.6NH_3]Cl_2$, where the ratio has been increased to 1·41, gives a structure of the fluorspar type. If, however, iodides are considered instead of chlorides, the negative ion has such a large diameter (2·19 A.) that it is impossible to find a simple cation of sufficient diameter to produce this effect. *All* metallic iodides of the type RI_2 therefore form layer lattices; but by making use of the complex cation, $[Ni.6NH_3]^{++}$, which has a much larger ionic radius (2·56 A.) than any simple cation, the ratio can be raised to 1·17 and the fluorspar lattice is again developed.

The influence of atomic radii on crystal structure is only precise when the ions can be treated as undeformable spheres, and is subject to profound

disturbances when the ions are 'deformable', as postulated by K. Fajans in 1923. This phenomenon depends on polarisation, and forms the subject of twenty of the most important pages of the monograph. Thus, in compounds of the type AB_2, the small undeformable fluoride ions generally give the ordinary 'co-ordination' type of ionic lattice as in fluorspar: but when a small and therefore strongly polarising cation is associated with a large and therefore easily polarised anion as in CdI_2, the tendency to form layer lattices is enormously increased; and this is in many respects a half-way stage in the direction of the formation of molecular lattices such as are found in crystals of calomel, ClHgHgCl. Attention is also directed to the fact that many hydroxides, for example, $Mg(OH)_2$, $Cd(OH)_2$, $Fe(OH)_2$, $Ni(OH)_2$, $Co(OH)_2$, have the same structure as CdI_2, and this is attributed to the fact that the hydroxyl ion is a strong permanent dipole.

An interesting development of these considerations is found in the phenomenon of 'counter-polarisation', when a complex ion is pulled to pieces by the influence of a rival centre of polarisation. Thus the distance between nitrogen and oxygen in $NaNO_3$ is 1·22, but is increased to 1·25 in $LiNO_3$, where the oxygens are subject to the strong polarising influence of the compact lithium ion and are thus drawn away from the central atom of nitrogen. In $CaTiO_3$ this process is carried a stage further, since the distances of the oxygen from titanium and calcium correspond so closely with the normal ionic radii that the formation of a complex anion can scarcely be detected; and in $MgTiO_3$ the break-up of the complex anion appears to be complete, since the crystal behaves as an aggregate of oxygen ions, interspersed with ions of magnesium and of titanium, with a similar structure to corundum, Al_2O_3. Thus a crystal of the type ABX_3 has been conformed to the type A_2X_3 by breaking up the radical BX_3 by a process of 'counter-polarisation'. As a still more extreme case, it is suggested that in spinel, $MgAl_2O_4$, the aluminate radical has been broken up by counter-polarisation, with formation of a new radical MgO_4, and that when Mg is replaced by Be, the structure of Al_2BeO_4 is of the type A_2BX_4, in which the complex ion BX_4 is fully developed as in K_2SO_4.

In all these discussions the inorganic salt is considered as an aggregate of simple ions, consisting of a single more or less polarisable atom with an appropriate positive or negative charge, and, following Kossel's theory of valency, the formation of chemical bonds is in the first instance entirely ignored. Thus the NO_3 and CO_3 ions are treated as aggregates of O^{--} ions surrounding a highly charged cation, C^{+4} or N^{+5}. To chemists, Kossel's method of formulation is intolerable, even in compounds such as CCl_4 and CH_4, and becomes absurd in compounds such as CH_2Cl_2, where the central atom of carbon would be neutral and therefore entirely unable to hold the 'ions' of H and Cl. It is therefore of interest to record the conclusion (p. 101) that "The conception that there are different kinds of chemical binding is completely confirmed by the results of the investigation of crystalline substances". As a criterion, it is noted that the sum of the atomic radii remains constant in series such as

		CuBr	AgI
BeO		ZnSe	CdTe
BN	AlP	GaAs	InSb
CC	SiSi	GeGe	α SnSn

when the total number of valency electrons is kept constant but the nuclear charges are distributed differently. On the other hand, a contraction of about 11 per cent occurs when the same process is effected in compounds of the series

NaF	KF	RbF	NaCl	KCl	RbCl
MgO	CaO	SrO	MgS	CaS	SrS
NaBr	KBr	RbBr	—	KI	RbI
MgSe	CaSe	SrSe	—	CaTe	SrTe

The members of the wurtzite, zinc blende and diamond group are therefore essentially different from the rock salt group, in accordance with the chemist's conception of diamond as a network of atoms held together by bonds, but of rock salt as an aggregate of ions. It therefore appears that in the former series the length of the bonds is not affected by juggling with the nuclear charges, whereas in the latter series the closeness of the packing is influenced very greatly by the magnitude of the ionic charges. As interesting exceptions, it is noted that TiC and ZrC, although they have structures of the rock salt type, resemble the diamond as regards the effects of substitution, whilst MgTe and AmF, which have a lattice of the wurtzite type, resemble rock salt in this respect.

An important part of the monograph deals with the phenomena of isomorphism, polymorphism and morphotropy. 'General isomorphism' is defined as depending on similarity of crystal structure, whilst 'special isomorphism', which carries with it the characteristic of 'isomorphous miscibility', requires that the ionic radii shall not differ by more than about 15 per cent on the smallest radius. 'Antisomorphism' is a variant on general isomorphism, in which the signs of the ionic charges are reversed, but it never gives rise to isomorphous miscibility. Thus ThO_2 and Li_2O are described as having an '*iso*fluorite' and an '*anti*fluorite' structure. So also '*iso* layer lattices', such as $NiCl_2$ and

CdI_2, in which polarisable anions are packed on either side of a layer of polarising cations, have their counterpart in '*anti* layer lattices', in which polarisable cations are packed on either side of a layer of polarising anions as in PbO or in one form of La_2O_3. 'Polymeric isomorphism' serves to describe the similarity of structure of polymers such as Ti_2O and $FeNb_2O_6$; it is not incompatible with isomorphous miscibility, but does not warrant the deduction that rutile contains molecules of the type Ti_3O_6.

Polymorphism depends on the fact that the relative stability of different types of ionic lattice may be influenced by changes of temperature and pressure, just as it can be influenced by substitution, for example, of Cs for Na in rock salt, or of I for Cl in $[Ni.6NH_3]Cl_2$. This effect is, however, attributed mainly to variations of polarisability, since the relative changes of ionic radii are too small to produce changes of structure. When the changes of structure produced by substitution are too great to be compatible with isomorphism, they are described as morphotropy. Thus changes of structure resulting from altered thermodynamic conditions give rise to polymorphism, whilst those resulting from substitution give rise to morphotropy. Polymorphism therefore occurs when the effects produced by alterations of temperature and pressure exceed the limits of 'self-isomorphism', and is specially characteristic of those substances in which chemical substitution gives rise most readily to morphotropy.

Although the author has given an interesting account of researches on crystal chemistry made during the past ten years, he does not even mention the important pioneer work done by Barlow and Pope between 1906 and 1910. He has, however, paid them the compliment of reproducing (without acknowledgement) photographs of two of their models of close-packed aggregates of spheres, which he ascribes to a German paper published in 1928. The actual models were prepared for a Friday evening discourse at the Royal Institution on April 15, 1910, and photographs (which can be recognised with certainty as the originals of Figs. 1 and 2 of the present monograph) were reproduced in the *Proceedings of the Royal Institution* (vol. 19, pp. 826–827, 1910) and at a later date in the *Proceedings of the Royal Philosophical Society of Glasgow* (1914). The reviewer has a personal interest in that the models, which were photographed again for use as illustrations in his "Inorganic Chemistry" (1922 and 1931), are now in his keeping and are used regularly in lecture demonstrations for Part II of the Tripos.

The price in English currency is about fifteen shillings for a pamphlet of 115 pages.

T. M. LOWRY.

Historical Geology

(1) *Historical Geology.* By Prof. Raymond C. Moore. Pp. xiii+673. (New York and London: McGraw-Hill Book Co., Inc., 1933.) 24*s.* net.

(2) *A Textbook of Geology.* Part 2: *Historical Geology.* By Prof. Charles Schuchert and Prof. Carl O. Dunbar. Third edition, largely rewritten. Pp. vii+551. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 25*s.* net.

(3) *The Principles of Historical Geology from the Regional Point of View.* By Prof. Richard M. Field. Pp. xii+283+10 plates. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1933.) 20*s.* net.

THE branch of geology with which these volumes are concerned deals with two thousand million years of the earth's history. It traces from the beginning the succession of geographies, the rise and decline of great mountain chains and the orderly evolution of life that have produced our modern world. The grandeur and interest of such a theme need no emphasis. Unfortunately, the subject is all too easily made unattractive and indeed unintelligible by the presentation of a host of seemingly unrelated facts. The general conceptions of the evolution of the earth and of its inhabitants are hidden. Properly pursued, historical geology should be one of the great disciplines, as it requires accuracy of reasoning, a rigorous sifting of evidence and completeness of observation. General works on the subject should be concerned more with methods of thought than with results.

(1 and 2) The books by Prof. Moore and by Profs. Schuchert and Dunbar have many points of resemblance. Both are excellent introductions to the study of earth-history. In each, an endeavour is made to show the methods by which a summary of the geological history of North America is obtained. After introductory material, the geological systems are examined in order, and the succession of events, the life and the palæogeography of the times discussed. Both works are attractively written, and are illustrated by a large number of maps and sections, and photographs of rock-exposures and characteristic fossils. The non-American student of geology is here provided with a couple of interesting guides to North American stratigraphy, whilst the more general reader can find plenty of entertainment, especially perhaps in connexion with zoological evolution.

(3) The third book, that by Prof. Field, is different. It is based on the brave new idea of teaching historical geology as certain law schools teach law—by selecting cases for elucidation and

discussion. Classic geological areas—the Grand Canyon, the Niagara Falls region, the Appalachians, the North-west Highlands and the Alps—are considered in detail, so that a series of lessons in tectonics of increasing complexity is presented to the student. The most important illustrations of the book are ten folding plates, mostly block diagrams, contained in a pocket at the end. The intention of the book is excellent but, unfortunately, the intention is not everywhere fulfilled.

At the outset, a feeling of irritation—if not distrust—is produced by the presence of a loose sheet bearing a long list of errata, such as "*for* Murchison *read* Sedgwick, *for* James *read* George", and this feeling is intensified by the discovery, soon made, that all errors are not on this loose sheet and that the loose sheet itself requires correction. The work is curiously uneven. Certain aspects of historical geology are well demonstrated and there are many passages in which the philosophy of field geology is charmingly and clearly put. But there are other pages that are clumsy and obscure, whilst the inclusion of a semi-popular guide to the Yellowstone Park seems scarcely necessary. It is greatly to be regretted that the excellent purpose of the book is not more nearly attained. H. H. R.

The Science of Farming

Agriculture: the Science and Practice of British Farming. By Prof. James A. S. Watson and James A. More. Third edition, revised and enlarged. Pp. x+777+35 plates. (Edinburgh and London: Oliver and Boyd, 1933.) 15*s*. net.

THE fact that this book has now reached its third edition shows that it serves a useful purpose; it is indeed a greater tribute than it would be for a purely scientific work, in view of the well-known reluctance of agricultural students to purchase books.

Much of the book has been revised, and fresh sections have been added dealing with the new fertilisers and cultivation implements, new varieties of barley and modern methods of treating grassland, while since the first edition new chapters have been added on sugar beet and on farm costs. In accordance with modern tendencies on the farm, more space is devoted to pigs, while poultry have been given an entire chapter and a new chapter is added setting out the details of breeding, of rearing and of the various methods of keeping a commercial laying flock, including the vitally important question of costs. The account of the systems of farming in Great Britain has been expanded and greatly improved by the addition of details concerning the amounts of capital required and the probable costs and returns under present-day conditions. There is also a useful account of the comparative costs of working by horse and by tractor, and the chapter on costing contains much information about the difficulties of arriving at any result and the significance of the figures when they are obtained: actual examples are given of costs of grazing, sugar beet production and milk production. A useful addition to the tables is one showing the amounts of work normally expected per day when a man is doing various operations.

The book is clearly written, the information is sound and well set out so that the reader easily finds what he wants. It includes much material not easily otherwise obtainable and can be strongly recommended to agriculturists who do not already use it.

Since the first edition appeared, the volume has increased by some 120 pages and is now not far short of 800 pages. If, as seems likely, a fourth edition is called for, the authors might consider cutting out much of the general parts on soils, fertilisers and animal nutrition which the student should get from his agricultural chemistry course, and of the section on Mendelism which should come into the biology course; the day is gone when one and the same man is expected to expound both sex linkage and hydrogen ion concentrations, to say nothing of colloids and metabolisable energy. These sections are quite well written and could make a separate and useful guide to farmers on the principles of science that underlie farming operations; and their removal would liberate space for further additions on the practical side, and especially for fuller descriptions of actual farm practices, husbandry systems and other matters here treated more fully than elsewhere. So the book could continue its useful career without becoming too unwieldy.

Nutrition and Disease

Nutrition and Disease: the Interaction of Clinical and Experimental Work. By Dr. Edward Mellanby. Pp. xix+171+52 plates. (Edinburgh and London: Oliver and Boyd, 1934.) 8*s*. 6*d*. net.

DR. E. MELLANBY delivered the Croonian lectures before the Royal College of Physicians, and the Linacre lecture at Cambridge, in 1933 and gave an account of his researches on various problems of nutrition and disease. Their publication is most welcome since such important matter should be considered at leisure. The book opens with a summary of the well-known and valuable work of Dr. and Mrs. Mellanby on rickets and dental caries and the

discovery of vitamin D, a milestone in the progress of medical science. Their new work deals with the inhibitory action on vitamin D of oatmeal and wheat germ which appears to be due to the phytic acid in these cereals interfering with the calcium and phosphorus supply in the diet.

Dr. Mellanby insists that liability to infections can be reduced by proper diet. Septic lesions occur in human beings and animals whose food is almost devoid of vitamin A or its precursor, carotene. Vitamin A therapy lessens mortality in puerperal sepsis, in septicæmias and in infections following measles. Pyorrhœa in dogs is caused by a deficiency of vitamin A, and is prevented by this vitamin.

The nerve degeneration, a demyelination of the fibres of the posterior roots, which is responsible for the inco-ordinated movements in rickets, is due to a deficiency of vitamin A in the diet. The similarity of the nerve lesions in beriberi to those produced by lack of vitamin A points to the neuritis in beriberi being caused by deficiency of vitamin A. Deficiency of vitamin B produces prostration which is rapidly cured by administration of vitamin B, whilst the paralysis, slower to yield to treatment, is relieved by vitamin A.

The dietetic errors responsible for the nervous disorders in ergotism, lathyrism and pellagra are probably due to deficiency of vitamin A. Again, cereals interfere with the action. An unknown neurotoxic substance is counteracted by increased vitamin A.

Combined experimental and clinical studies of simple and toxic goitres show that their etiology differs fundamentally. Simple goitre is caused by a deficiency of iodine in the food and is reduced by iodine therapy. In toxic goitre there is local absence of iodine in the thyroid and excess in the blood, due to withdrawal as fast as it is formed of the colloid together with its active principle. In exophthalmic goitre, iodine therapy is only palliative and has its dangers. The iodine withdrawal from the thyroid is initiated by a chemical substance in the anterior part of the pituitary gland.

The value of the book is not only as a record of fruitful research but it is significant also as an emphatic justification of the alliance of research worker and clinician. The practice of medicine tends to remain a religion of traditional beliefs and empirical knowledge passed on from senior to junior physician. A chair of dietetics may be founded in connexion with a large hospital, but if the chair may not be placed by the bedside as well as in the laboratory, of what is its use? It is salutary to remember Pasteur and the indebtedness of medicine to a mere chemist. The book is one to buy and read, and not to borrow.

Short Notices

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 12: *Elektrochemie.* Teil 2. Herausgegeben von K. Fajans und E. Schwartz. *Elektromotorische Kräfte,* von Prof. Dr. C. Drucker und Prof. Dr. C. Tubandt; *Polarisationserscheinungen,* von Prof. Dr. R. Kremann; *Elektrochemie der Phasengrenzen,* von Prof. Dr. E. Lange und Dr. F. O. Koenig. Pp. xix+483. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.) 40 gold marks.

THIS volume, the second part of the section on electrochemistry in the Wien-Harms "Handbook", well maintains the standard of thoroughness of earlier volumes. Drucker writes competently on electromotive force in cells with liquid electrolytes, without, however, making much attempt to describe the atomic or electrical mechanisms involved, except in the liquid portion of the system, or the relationship between the affinity of the metals for electrons and their electromotive powers. The classical electrochemistry of all the usual types of cells is well and clearly treated. Tubandt contributes a short section on cells with solid electrolytes.

Kremann gives a valuable and very well documented account of polarisation phenomena, including, of course, passivity and overpotential; in this section, theory, as is perhaps inevitable when dealing with such a quantity of unruly experimental data which will not enter the harmonious thermodynamic edifice devised to house the more docile phenomena of reversible cells, is weaker than the description of experimental results.

The last two hundred pages are devoted more specifically to phase boundary potentials. Lange deals thoroughly with the methods of measuring Volta potentials, between liquids and air as well as between two metals, but is not up-to-date in the description of the influence of surface films on these potentials. The Peltier effect and dropping mercury electrodes are well treated, the former especially thoroughly. There is one real gem in this volume: Koenig's treatment of the electrocapillary curve on pp. 376–416. This is based on a partly new and original thermodynamic treatment which avoids the improbabilities of earlier treatments, and is very ably worked out and applied to all the more important experimental observations; the chapter closes with a good account of the molecular theory of the double layer. A somewhat brief but very clear account of electrokinetic phenomena is also contributed by the same author, whose critical handling of these two difficult subjects is in many respects original and is probably unsurpassed anywhere in scientific literature.

N. K. A.

Law and Order in Polynesia: a Study of Primitive Legal Institutions. By Dr. H. Ian Hogbin. Pp. 296+8 plates. (London: Christophers, 1934.) 12*s.* 6*d.* net.

DR. HOGBIN's study of social regulation in Polynesia adds another to the series of monographs on the ethnography of 'primitive' peoples, which has been inspired by the methods and theories of Prof. B. Malinowski as the founder of the school of 'functional anthropology'. The investigations in Ontong Java, perhaps better known as Lord Howe's Island, in the western Pacific, which are the major source of his book, were carried out by Dr. Hogbin under the auspices of the Australian National Research Council and the University of Sydney; but the book itself was written in London as a thesis for the Ph.D. These details are by no means unimportant. They point to the formative influences which have determined the character of Dr. Hogbin's work; he has been a pupil of Prof. A. R. Radcliffe-Brown and Prof. Malinowski; and his approach to his problem, therefore, has been entirely that of the 'functional' school. Given this point of view, his work is of a high standard in its careful observation, valid argument and lucid exposition.

In detail, Dr. Hogbin's work shows how, functionally considered, individual relations, as elements in situations conditioned by the various group organisations of Polynesian society, are essentially a reciprocity, a co-operative activity, which involves an observance of social and religious obligation. Law and order, thus regarded, cease to be a matter of sanctions or of imposition by a higher authority, but are inherent in function and, in the normal course, sufficiently powerful to overcome any individual inclination to transgression.

It will be seen that this interpretation of law and order differs *toto cœlo* from the outlook of jurisprudence. If the method is sound—there is no desire to raise the question in this connexion—it is necessary, in the interests of comparative study, to find some mode of reconciliation. Otherwise the study of the growth of law and legal institutions is left hanging in the air.

Prof. Malinowski resolves the difficulty in an introduction to Dr. Hogbin's work, in which it is shown that the gap which appears to lie between 'primitive' and civilised, from the point of view of the orthodox jurist, vanishes in the light of an analysis of custom, law, and social and legal institutions, as functionally co-operative to secure the satisfaction of human needs—biological, physiological and psychological.

Le poison des Amanites mortelles. Par R. Dujarric de la Rivière. Pp. 182+24 plates. (Paris: Masson et Cie, 1933.) 60 francs.

FROM the earliest times, toadstools have had the reputation of being poisonous, and most people know some way or other of distinguishing which of them by chance is edible. The fact is, however, that *Amanita phalloides* and its near allies, are the only deadly species, and very few others cause serious inconvenience: it may be added that *A. phalloides* 'peels' and does not turn silver black!

In the monograph under notice this common species is considered from every point of view; the somewhat rare *A. verna* and *A. virosa* are treated, but with much less detail. Four excellent coloured plates show the three species in a way which should ensure their ready recognition.

The main interest in the volume is the medical consideration of the fungus-poison both from the physiological viewpoint and that of pathological anatomy. Here is contained a good deal of original investigation. Two of the plates give forty-five photographs taken from a film of the different attitudes of a mouse after a dose of the toxin of *Amanita phalloides.*

It seems a little alien to our insular ideas to find a chapter on the medico-legal aspect of fungal poisoning, but it is reported that in Great Britain during 1837–38 statistics gave 4 out of 541 cases of criminal poisoning as caused by fungi. It appears that in France the vendor of fungi is legally responsible for their edibility. There is a chapter on prophylactics, a very full list of references, and a list of papers on poisonous fungi published in the *Bulletin de la Société Mycologique de France.* J. R.

Counter Attack from the East: the Philosophy of Radhakrishnan. By C. E. M. Joad. Pp. 269. (London: George Allen and Unwin, Ltd., 1933.) 7*s.* 6*d.* net.

THE apparent chaos of Western civilisation suggests to Prof. Joad the idea of seeking our salvation through Eastern channels, and this he enthusiastically proposes through an analysis of Radhakrishnan's philosophy. The contribution of Indian thinkers to philosophical discussion is no doubt exceedingly valuable and suggestive; but it is with some reluctance that one would blindly turn to it for exclusive inspiration unless one has fairly well exhausted the possibilities of the West. Occasional remarks about the religious and mystical thought of the West make one rather suspect of Mr. Joad's knowledge of them. But apart from this initial difficulty, the reading of this work will prove to many of singular interest, both in its expository statements and in the contrast it marks out between East and West.

La science française depuis la xvii^e siècle. Par Prof. Maurice Caullery. (Collection Armand Colin: Section de Philosophie, No. 165.) Pp. 215. (Paris: Armand Colin, 1933.) 10.50 francs.

PROF. CAULLERY gives a bird's-eye view of French scientific thought from the seventeenth century to the present day, He could scarcely do more than that in the small compass of his book, which thus suffers from unsupported generalisations, especially about the Middle Ages and about the philosophical bearings of the theories discussed. As an introductory book, it will be found very useful and inspiring, though his bibliography is not quite up-to-date. T. G.

The Problem of Ether Drift*

By DR. C. V. DRYSDALE, C.B., O.B.E.

ANALYSIS OF THE MICHELSON-MORLEY OBSERVATIONS

IT should be noted that as the displacement of the fringes is proportional to the square of the velocity of drift, a velocity of 10 km./sec. only corresponds to a displacement of about 0·1 of a fringe, and, as the width of the fringes could not be kept quite constant, visual estimation to the nearest 0·1 fringe was all that was possible for the enormous number of observations which have been made. Hence the existence of a drift could only be determined by averaging a large number of sets of observations at sixteen equally-spaced azimuths, and by employing a Henrici harmonic analyser to determine the component of double period in a revolution. The results of this analysis reveal a small full-period component which was accounted for satisfactorily by Hicks in 1902 as due to the small inclination of the mirrors required to produce the fringes, and a relatively large double-period component, the amplitude of which represents the component of the drift in the plane of the interferometer. The sum of the higher harmonics is usually relatively small, which indicates that the drift effect is real. This procedure seems first to have been adopted for the Mount Wilson observations of 1921, which explains why various interpretations could be put upon the earlier Michelson-Morley results. Miller has, however, since applied it to these earlier observations, and has therefore come to the conclusions above stated.

But the harmonic analyser gives the phase as well as the amplitude of the double period component, and therefore the azimuth of the horizontal component of the drift. By taking observations at several intervals during the day and correlating the magnitudes and azimuths of the drift with the geographical position of the interferometer and the movements of the earth, it became clear that the drift observed was not chiefly caused by the orbital motion but by a motion of the whole solar system in a direction nearly perpendicular to the plane of the orbit. Further observations were therefore made at Mount Wilson in April, August and September 1925, and in February 1926, in order if possible to determine the sense as well as the direction of the absolute motion, as the interferometer is of course 'bi-directional'. The four apices of the motion, which can be determined independently from the amplitudes and the phases of the observed drifts, were found to lie almost exactly on a circle which is the 'aberration orbit' of the earth; and this led to the conclusion that the solar system must be moving towards the constellation Dorando in a direction 7° from the south pole of the ecliptic, and with a velocity of about 208 km./sec.

The above velocity was derived by calculation from the orbital velocity of the earth and the directions of the drift at the various epochs; and as it is about twenty times the velocity of the drift given by the interferometer, it would appear either that the earth imparts a material fraction of its velocity to the ether near its surface, which is highly improbable, or that the Fitzgerald-Lorentz contraction differs by five per cent from the truth.

It is impossible to read Prof. Miller's account of these laborious researches, with the meticulous care they reveal, and the remarkable consistency of the results, without feeling that a drift has actually been observed; but, on the other hand, Michelson himself, Piccard and Stahel, Kennedy, and Zoos have recently made careful trials with various modifications of the interferometer, and have all failed to detect any definite evidence of drift. Miller, however, is definitely of the opinion that the drift can be screened by thick walls or metallic enclosures, and points out that nearly all these instruments were so enclosed. At a conference held at Mount Wilson Observatory in 1927, at which Michelson, Miller, Lorentz and Kennedy were present, Miller was the only champion of a positive result, and Lorentz confessed that at a previous conference at Düsseldorf in 1898 the conviction against the detection of at least a first order effect became so strong that attention was only paid to those papers which announced negative results. Nevertheless, the impression created by Miller was considerable, and Michelson proposed to carry out a further trial with an invar-framed interferometer and further optical refinements.

So the matter rests at the present time, but it is clear that it is in a very unsatisfactory state, and that it cannot be settled by any improvements in the Michelson-Morley apparatus, or by any other method based on a second order effect, on account of the doubt concerning the exact amount of the contraction or rather distortion which theory indicates must exist, apart from the extreme delicacy of the method.

IS A FIRST-ORDER EFFECT UNOBTAINABLE?

It is evident, therefore, that a first-order effect is imperatively needed to clear up the problem, but the complete failure of all attempts to detect

* Continued from p. 798.

a change of deviation or of the time of transit through dense transparent media, combined with the theoretical impossibility of doing so if the Fresnel drag formula is accurately true, has led to a universal disbelief in the possibility of observing a first-order effect; just as the supposed null results of all experiments by the Michelson-Morley method, combined with the Fitzgerald-Lorentz contraction formula, have evoked disbelief in the possibility of detecting a second-order effect. Indeed, the denial of any possibility of detecting motion through the ether has become a cardinal assumption of the general theory of relativity. This denial has been emphatically stated by Prof. R. W. Wood in the last edition of his "Physical Optics", where he says that the first postulate of the theory of relativity "amounts to saying that motion through the ether (if the ether exists at all) will be wholly without influence upon all optical experiments made with terrestrial sources of light".

But the Maxwellian theory, as developed by Drude and by Lorentz, definitely indicates the possibility of observing a first-order effect, and as a matter of fact such an effect was actually observed, as early as 1859, by Fizeau, who conceived it from the then existing theory. As is well known, Drude was the first to introduce the modern conception of mutually attracting ions into optical theory, and thereby to develop a remarkably successful theory of dispersion as well as of most other optical phenomena. Following on the same lines, Lorentz in 1895 published an important paper on electrical and optical phenomena in moving bodies, in which he established the Fresnel drag formula on a sound theoretical basis and gave an outline of the theory of the "contraction" effect. These important developments have helped greatly to clarify our conceptions.

One fundamentally important conclusion which emerges from the above theories and from the moving water experiments of Fizeau, Michelson and Morley, and Zeeman, is that motion through the ether has a definite meaning and measurable effect. The failure of all interferometer and deviation experiments with dense media to reveal any effect of the earth's motion through the ether is simply due to the fact that the effects which are undoubtedly produced when the light enters the dense medium are exactly cancelled by its subsequent passage through the medium. In the case of a block of dense medium interposed in an interferometer and moving in the direction of propagation, the increase in the velocity of propagation due to the motion is exactly balanced by the increase of the effective length of the block. A transverse motion, on the other hand, produces a change in the angle of incidence of the wave front equal to the aberration, and therefore a corresponding deviation of the refracted wave front, but this deviation is exactly neutralised by the transverse drag of the medium as the light proceeds. The fact that no resultant deviation can be observed is therefore an experimental proof of a deviation of the refracted wave front, unless we assume that the ether near the surface of the earth is carried along with it, which would be contrary both to the Maxwell-Lorentz theory and to the observations of astronomical aberration.

Both theory and experiment therefore agree in indicating that a transverse drift alters the refraction at the surface of a dense medium, so that it is clear that any effect of that change at the surface which is unmodified by subsequent passage of the light through the medium should be capable of observation.

Such an effect is available in the polarisation which occurs at oblique incidence on an isotropic dense medium. According to the Maxwellian theory, this polarisation depends simply upon the inclinations of the incident and refracted wave fronts to the surface; and the angle of complete or maximum polarisation of the reflected light is given by $\tan\theta = n$. Jamin has shown that this polarisation is practically complete at the polarising angle for substances having a refractive index of about 1·46, so that it would appear that a simple blackened-glass polariscope should show a change of about 37 seconds in its polarising angle when it is rotated in the plane of the earth's orbit.

Of course, such a small effect would probably be difficult to measure, but it may be amplified considerably by making use of the rotatory effect of an oblique plate on an already polarised beam; and this was the method employed by Fizeau, who used a pile of forty thin glass plates of slightly prismatic form so as to deviate the reflected beams away from the transmitted beam, the rotation of which was observed. His observations, which were conducted with three different dispositions of the apparatus, gave rotations in some cases of as much as 2½ degrees; and they varied with the orientation of the apparatus and time of day as anticipated. They also agreed fairly closely with his predictions from the then existing theory, but these are perhaps open to criticism.

There can be little doubt, however, in the light of our present knowledge, that the basis of Fizeau's method is sound; and it is a remarkable testimony to his prescience and ingenuity that he should apparently have realised the necessity for what may be called a "surface method" and have devised such an ingenious method of carrying it into effect at such an early date. Unfortunately, he does not seem to have realised its importance in relation to the ether drift problem, and devised it primarily for the purpose of extending his verification of the

Fresnel drag formula to solid substances; neither did he give any cogent reasons for having adopted this particular method; so that his remarkable research has scarcely attracted any attention.

After a comprehensive survey of the problem, however, the present writer is convinced that the surface polarisation method does provide a means of measuring a first-order effect of ether drift, and that Fizeau's experiments have actually demonstrated such an effect. There seem to be various possibilities for simplifying the method, with which it is hoped to experiment before long; but in the meantime, this account of Miller's and of Fizeau's experiments may do something to revive interest in this important problem and to dispel the prevalent belief that it is insoluble.

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The Study of Behaviour*

By DR. E. S. RUSSELL, O.B.E.

IT was Descartes who imposed upon European thought for at least two centuries, and upon biology for much longer, that 'bifurcation' of Nature into matter and mind which has raised so many insoluble problems for philosophy, and diverted biology from its true method. As to its effect on philosophy, Prof. A. N. Whitehead writes:

"The seventeenth century had finally produced a scheme of scientific thought framed by mathematicians, for the use of mathematicians. . . . The enormous success of the scientific abstractions, yielding on the one hand *matter* with its *simple location* in space and time, on the other hand *mind*, perceiving, suffering, reasoning, but not interfering, has foisted on to philosophy the task of accepting them as the most concrete rendering of fact. Thereby, modern philosophy has been ruined. There are the dualists, who accept matter and mind as on equal basis, and the two varieties of monists, those who put mind inside matter, and those who put matter inside mind. But this juggling with abstractions can never overcome the inherent confusion introduced by the ascription of *misplaced concreteness* to the scientific scheme of the seventeenth century."

Actually, instead of being the most concrete of realities, both matter and mind are highly abstract concepts, the product of the reflective intelligence working upon the data of immediate experience.

There is given in individual experience only the perceiving subject and his objective world. This dualism does not correspond, is not synonymous with, the dualism of matter and mind. Subjective experience as we know it directly is a function of organism, not of pure mind; objective experience is a relation between organism and other processes or events. The concept of matter is arrived at by abstracting from the data of sense, by leaving out the 'secondary qualities' such as colour, smell and sound, and retaining the so-called 'primary qualities' of resistance and extension, with location in time and space.

By accepting this abstract definition or concept of matter, we substitute for the objective world of perception a symbolic or conceptual world of discrete material particles, which we may call the 'world of matter'. This world of matter the materialist takes to be in some sense more real than the perceptual and colourful world from which he has derived it. Actually it is less real, less concrete. It is important to remember that the world which we perceive through the senses, with its shapes, colours, smells, tastes and so on, is not identical with the conceptual 'world of matter'; we do not perceive 'matter' at all, any more than we perceive mind; we perceive things or relations or events.

Complementary to this abstract material universe is the concept of mind as an inextended, immaterial, thinking entity, and this also is

* From the presidential address before Section D (Zoology) of the British Association, delivered at Aberdeen on September 6.

derived by abstraction from the data of immediate experience, and principally from the subjective aspect of experience.

As applied to biology, this abstract dualism has saddled us with the theory that the organism is a machine, with the pale ghost of a mind hovering over its working, but not interfering. What chance is there for a real science of animal behaviour if this metaphysical view is accepted ?

Obviously from the Descartian point of view, behaviour becomes a subject for the physiologist to study from his analytical point of view ; he must regard behaviour as the causally determined outcome of the working of the animal machine, under the influence of external and internal stimuli, and he must seek to determine the elementary physico-chemical processes out of which behaviour is built up. The physiologist as such can have nothing to do with mind, and hands over its study to the psychologist, who finds that he can know nothing directly about the minds of animals. Hence we get the study of animal behaviour split up between physiology and psychology, with no possibility of a connecting bridge. The scientific study of behaviour thus becomes divorced from natural history, and ceases to take its rightful place as an integral part of zoology.

Aristotle knew better than this ; he regarded life and mind as continuous one with another, and the basis of his zoological system was the form and activity of the animal as a whole. But then Aristotle was a first-rate field naturalist and observer.

Let us try to rid our minds of the abstract notions of matter and mind, and regard the activities of living things without metaphysical preconceptions. As zoologists, our job is to study animals in action. Let us try to approach our task with the same directness and *naïveté* that Aristotle showed when he laid the foundations of our science. Instead of assuming *a priori* that the physico-chemical or analytical method of approach is the only possible and the only fruitful one, let us try the alternative of considering first the most general characteristics of the organism as a whole, and working down from the whole to the parts, rather than up from the parts to the whole, as is the more usual method.

Taking this simple and direct view of living things, abandoning theory and accepting the obvious facts at their face value, we see first of all that the complete phenomena of life are shown only by individuals, or organised unities. Sometimes these units are combined loosely or closely in unities of higher order, as in social insects and in colonial animals, such as corals, but these cases scarcely affect the main thesis that life is a function of individuals. There is accordingly no such thing as 'living matter', save as part of an organised unity.

The second thing we note is that all living things pass through a cycle of activity, which normally comprises development, reproduction and senescent processes leading to death. This life-cycle is in each species a definite one, passing through a clearly defined trajectory, admitting of little deviation from normality ; it takes place generally in an external environment which must be normal for the species, and as a rule the internal environment also is kept constant round a particular norm. The activities whereby the needs of the organism are satisfied and a normal relation to the external and the internal environment is maintained, may be called the maintenance activities of the organism, and they underlie and support the other master-functions of development and reproduction.

Our general definition or concept of organism is then an organised unity showing the activities of maintenance, development and reproduction, bound up in one continuous life-cycle. A static concept is inadequate ; time must enter into the definition ; the organism is essentially a spatio-temporal process, a 'dynamic pattern in time', as Coghill aptly calls it.

Now all these activities are, objectively considered, directed towards an end, which is the completion of the normal life-cycle. One is tempted to use the word 'purposive' in description of these activities, but this term is used in many senses and has a strong psychological flavour about it, so I shall use instead the neutral word *directive*, which I borrow from C. S. Myers. It is quite immaterial from our simple objective point of view whether these directive activities, or any of them, are consciously purposive. The directiveness of vital processes is shown equally well in the development of the embryo as in our own conscious behaviour.

It is this directive activity shown by individual organisms that distinguishes living things from inanimate objects. The peculiar character of this directiveness, its orientation towards a cyclical progression of organisation and activity, clearly distinguishes it from the static directedness of a machine, constructed for a definite purpose. It should be noted too that the living thing shows a certain measure of adaptability in completing its life-cycle, so that the end is more constant than the way of attaining it.

Now from this point of view, which is, I maintain, strictly objective, behaviour is simply one form of the general directive activity of the organism ; it is that part of it which is concerned with the relations of the organism to its external world. Plants show behaviour in this general

sense just as much as animals do, but they, being for the most part sessile and stationary creatures, respond to the exigencies of environment, and satisfy their basic needs, mainly by processes of growth and differentiation, and only exceptionally by active movements. Thus the dune plant seeking water grows an enormously long root which burrows down through the sand until moisture is reached. Animals on the other hand respond to environment and satisfy their needs by means of movements, either of the body as a whole or of certain organs. But sessile animals, like plants, may also respond or show behaviour by means of morphogenetic activity. The hydroid, *Antennularia*, for example, if suspended in the water may send out 'roots' or holdfasts to regain contact with the bottom.

Behaviour, whether of plants or animals, is thus to be regarded simply as one form of the general directive activity which is characteristic of the living organism. It holds no privileged position; it does not require 'mind' as an immaterial entity to explain it.

If we accept this view of organism, which is to my mind a simple generalisation of fact, we escape or elude the difficulties of dualism; we need no longer regard behaviour as either the mechanically determined outcome of the material organisation of the body, or the result of the activities of an immaterial mind or entelechy influencing in some utterly mysterious way the mechanical workings of the body. By taking as given and as fundamental the plain objective characteristics of the living and intact organism, by refusing to split it up into matter and mind, we avoid both materialism and its counterpart vitalism.

This is, as I conceive it, the central position of the modern organismal theory—the substitution of the concept of organism for the concepts of matter and mind. The concept of organism, or more generally of organised system, may of course be applied right down through the inorganic realm, wherever organised unities are found. Thus a molecule is an organised system, and so also is an atom. I do not, however, agree with those who think that all real unities, both organic and inorganic, are adequately characterised as 'systems'. In certain most general characteristics an atom and a living organism agree, for both are systems or wholes. But the living organism has characteristics which are lacking in inorganic systems, and it can be adequately defined or characterised only by reference to those peculiarities which we have just considered—the weaving together in one cyclical process of the master functions of maintenance, development and reproduction. These distinguish it from any inorganic object or construction, from any inorganic system. Underlying these characteristics is the general directiveness of its activities, their constant drive towards a normal and specific end or completion.

It will be noted that this organismal view makes no real distinction between life and mind, between vital activities and those which in immediate experience appear as mental or psychical activities. In this respect we hark back to a pre-Descartian mode of thought, and call Aristotle our master.

Simple observation shows us that living animals exhibit activities which are obviously not, on the face of them, those of a mechanism. Many of their behaviour actions are strictly analogous to those which in immediate experience we should describe as psychological. Thus we see animals trying hard to achieve some aim or end—a salmon struggling to surmount a fall, for example, or a cat using all its skill to catch a bird. We do not know whether these actions are consciously purposive or not, but we cannot dismiss the objective facts of striving merely by assuming that they are mechanically determined. There are the facts; animal behaviour is predominantly directive, or in an objective sense purposive, and there is no use closing our eyes to it.

It is well known too that many animals can learn and profit by experience. Thus if you train a puppy to play with a ball, this becomes of functional significance to it; it will go and look for its ball, which it remembers; and other objects of a similar size or shape acquire for it the functional value of a ball, and are used in play. There is here definite evidence of memory, or retentiveness.

In the same way, there is abundant evidence that animals perceive their surroundings, singling out those objects and those events that are of importance in relation to their needs. Of course we cannot know what the quality of these perceptions is, but we *can* determine by suitably planned experiments just what it is to which the animal responds, and we often find that the response is to patterns or images or relations, and not to a simple summation of physico-chemical stimuli. From the organismal point of view there is no difficulty in assuming that animals perceive and react to an external world of their own; here, as in our own case, perception may be regarded as a function of organism, not of 'mind'.

This is essentially the attitude of ordinary common sense. In practice we treat our fellow men and at least the higher animals as being real individuals with perceptions, feelings, desires, similar to our own; and common sense is in principle justified, though of course it runs a great risk of reading human motives, human ways of thought, into the behaviour of animals, and of

assuming without sufficient warrant that their perceptual worlds are the same as ours. But because there is a danger of faulty interpretation, due mainly to inaccurate or inadequate observation, we are not thereby compelled to throw over the general conception that the animal organism is capable of perception, conative behaviour, and memory, if the facts of observation lead us to this conclusion. I do not mean that we should explain behaviour as being due to psychological functions labelled conation, perception and memory—that would be an empty and barren explanation. We are concerned only with behaviour, not with the subjective experience of the animal, which cannot be the subject of scientific study. But we must describe the behaviour fully and adequately, using if necessary terms of psychological implication, refusing to be bound or hampered by the metaphysical notion that the animal is merely a machine or can be treated as such.

In affirming as we do that the animal organism in its behaviour shows a kind of activity which cannot be adequately described in terms of material configuration we are taking no great risk. Our own immediate experience is there to assure us that in one case at least the organism certainly does perceive, strive, feel and remember.

From the organismal point of view, the study of behaviour is neither comparative physiology nor comparative psychology; it is the study of the directive activity of the organism as a whole, in so far as that activity has reference to the organism's own perceptual world. It must start with what Lloyd Morgan calls the 'plain tale' of behaviour, the full and accurate description of what animals do, and of what they are capable.

The plain tale description of animal behaviour must begin with a study of the natural history and ecology of the animal. Most animals are restricted to one definite and rather specialised kind of environment; they are adapted both in structure and activity to inhabit some particular ecological norm or ecological niche. We must discover by field observation how the animal finds this ecological niche to begin with, and how it maintains itself therein. We must investigate how it counters changes in its environment, how it defends itself against enemies, how it finds or captures its food. All this is straight natural history in the old sense, the study of the 'habits' of animals, and it is linked up closely with the modern study of ecology. It is the necessary basis for the more detailed study of behaviour. It is also the clue to much of the behaviour shown in the artificial conditions of a laboratory experiment.

Clearly then we must start with direct observation of the animal's behaviour in the field, or in experimental conditions that approximate as nearly as possible to the normal. We must then ask what is the animal trying to do, what is the objective end or aim of its action? Sometimes the animal is doing nothing in particular; it is resting or merely waiting for something to turn up. Usually, however, the animal is active, is showing behaviour; its actions are directed to some end, are aimed at satisfying some need, and we can determine by observation and experiment what that end is; the sign that the end is attained is the cessation of the train of action.

We find very often that a simple directive activity is part of a general directive process of long range, which may take months to reach its goal; and to understand the simple action we must relate it to, or integrate it in, the general process of which it is a part. Take for example the building of a nest by a bird. This taken by itself is a directive activity, aimed at the construction and completion of an adequate brooding place for the eggs and young. It is a fairly stereotyped and specific activity, but unusual materials may be pressed into service if the normal materials are hard to come by. But nest-building is simply one link in the long reproductive cycle, which may commence with migration, and its relation to that cycle, which includes both behavioural and physiological activities, must be studied if we are to understand it fully.

This illustrates the general rule of biological method which we have just discussed—that the whole life-cycle of activity must be regarded as the primary thing, and that the parts of it which may be isolated for study must be re-integrated in the whole-activity. The human mind is prone to analysis, and we must be on our guard against its inveterate tendency to separate and distinguish parts or elements in what are, fundamentally, continuous processes.

In thus relating partial events to life-cycle, we must of course consider above all their time-relations, not only their relations to what has gone before, but also and more particularly to what follows after. I should like to refer in this connexion to a recent address by Coghill, in which the organismal view of development, including the development of behaviour, is set out with great clearness and authority. He tells us that:

"the neuro-embryologic study of behavior shows that events within a behavioral system can be understood scientifically only as their relation is known to subsequent as well as to antecedent phases of the cycle. The antecedent tells a part of the story about the present, but not all of it; for within the present are events that have behavioral significance only in that which follows. . . . The purely scientific method, dealing

exclusively as it does with space-time relations, can not reject the future from its explanation of the present in behavior, because any event in an organismic cyclic system is an integral part of both the future and the past."

To conclude—it is time biology shook itself free from the limitations imposed upon it by a blind trust in the classical doctrine of materialism. This doctrine is not in harmony with the modern development of philosophical thought, nor with the modern development of physical science, and it is not well adapted to the study of living things.

We must adopt a more concrete and more adequate concept of the living organism, one that will take account of its essential characteristics. We must think of the organism as a four-dimensional whole, or directive cyclical process, and no longer attempt to contain it within the static scheme of the classical materialism. This does not lead to any form of dualistic vitalism. The relation of behavioural or 'psychological' activities to physiological is not the relation of mental to physical activities, but is, quite simply, the relation of a whole spatio-temporal directive process to its parts.

Finer Structure of Chromosomes

RECENT studies of the chromosomes in various somatic tissues of *Drosophila* and other insects is throwing further light on the processes of heredity. It has been known since 1881, when Balbiani studied the chromosomes in the salivary gland cells of the *Chironomus* larva, that they are relatively very large and are marked with transverse bands or discs. Last year, Prof. T. S. Painter expressed the view that these bands, which show equally in the giant chromosomes of the salivary glands of *Drosophila* larvæ, correspond with the locations of the genes. An exciting line of investigation is now being pursued, in which the positions of the discs or bands are compared in different genotypes of *Drosophila* having deficiencies, translocations and other alterations in their chromosomes.

In two recent papers in *Genetics* (May and September, 1934), Painter has made further studies of the bands of varying widths which occur at fixed positions on the chromosome, making a pattern which may be compared with a spectrogram. It is well known that in Diptera the somatic chromosomes are often closely paired, but he finds that in the salivary gland cells of old larvæ the homologous chromosomes fuse completely, "line for line and band for band", but it is not at present clear how this can take place. This somatic synapsis is accompanied by separation of the long chromosomes into two parts at the spindle fibre attachment, while about three-eighths of the *X*-chromosome—the portion found genetically to be free from genes—as well as the greater part or the whole of the *Y*, disappear completely.

By studying deletions and translocations in which a series of genes are present the position of which on the *X*-chromosome has been mapped, particular bands can be closely identified with particular genes. When certain genes are deleted, corresponding bands will be absent, and if a section of the chromosome is transposed, its bands and their affinities are correspondingly altered. By such methods the chromosomes can be more accurately mapped, and much breeding work can be eliminated by the direct observation of the position of known bands in the chromosomes.

In an investigation of the ganglion cells of *Drosophila*, Dr. Kaufmann (*J. Morph.*, 56, No. 1) has shown that some of them have satellites, and that, as in plant cells, certain chromosomes (in this case loci of the *X* and *Y*) are concerned in producing the nucleolus. He also finds the anaphase chromosomes double, consisting of two coiled chromonemata as in plant nuclei.

Following these advances in knowledge of the morphology and inner structure of *Drosophila* chromosomes, come fresh observations and speculations regarding the relation between the visible discs and the hypothetical genes. Prof. N. Koltzoff announces (*Science*, Oct. 5, 312) that the diploid somatic non-dividing cells in the salivary glands of insect larvæ contain giant chromosomes because the chromonema in each has divided successively to form probably 16 strands, which he calls genonemes. In addition to the discs at intervals on the chromosome, chromomeres are seen on the individual strands, and these structures can be photographed in the living cell. Koltzoff is inclined to regard the gene as corresponding, not to the chromomere but to the intervening portion of thread between two chromomeres, the discs being regarded as joints between the genes.

Dr. C. B. Bridges has independently come to conclusions in many respects similar, as announced by Science Service in the same number of *Science*. The chromosomes in the salivary glands of fruit-fly larvæ are in some cases seventy times the size of the ordinary chromosomes. By using a method for removing the outer chromatin, Bridges finds the solid discs composed of a bundle of parallel rods like a handful of cigarettes, threads connecting corresponding rods from one disc to another to

form a twisted cable. He concludes that each gene locus corresponds with a particular size or shape of chromomere, always in the same relative position. The sub-units of the discs are apparently regarded as the real genes, and many of them are believed to be no larger than one or a few molecules of the more complex proteins.

While Koltzoff and Bridges thus differ in certain of their interpretations, it is evident that they have both examined the same structures, and it has been shown that these giant chromosomes can be used in a further analysis of the ultimate structure of animal chromosomes and the relation of their finer structure to the processes of inheritance. This new line of investigation is one of much promise as rendering possible a more specific identification of genic structures in the chromosome.

R. RUGGLES GATES.

Obituary

PROF. JAMES MARK BALDWIN

WE regret to announce the death of the distinguished psychologist and philosopher, James Mark Baldwin, which occurred in Paris on November 8. Born at Columbia, South Carolina, in 1861, Baldwin, who originally intended to devote himself to the ministry, studied first at Princeton. Here he came under the philosophical influence of Principal McCosh, which left a lasting imprint upon his mind. Here, also under McCosh's sympathetic tuition, he became acquainted with the general theory of biological evolution and with the leading ideas of Wundt's recently published "Physiological Psychology". In the light of this early orientation, the subsequent development of his psychological interests becomes clear.

So impressed was Baldwin by the possibility of the then novel project of experimentation in psychology that, on gaining a graduation fellowship, he spent two semesters in Germany, studying at Leipzig, Tübingen and Berlin; and, as he himself says, the chief result of these studies was "a sort of apostolic call to the 'new psychology' ", which he accepted with enthusiasm. Returning as a teacher to Princeton, though still occupied with apologetics and theology, his 'call' soon led him to Mount Forest, where he was appointed to a chair in philosophy. This was the first of a number of university posts, including chairs at Toronto and Johns Hopkins, which he filled with great distinction; and here, dissatisfied with the barren associationism and structuralism of the textbooks of the day, he began his "Handbook of Psychology", in which he stressed his own developmental and functional theories.

At Princeton, Toronto and Johns Hopkins successively, Baldwin founded psychological laboratories on the model of Wundt's, where courses were given in experimental psychology, and numerous important researches were carried out; but in the end he became somewhat critical of the experimental method of approach because of the paucity of results in respect of the genetic problems with which he was mostly concerned; and he turned definitely to the study of mental origins, development and evolution that formed the abiding interest of his later work. This took the form, in the first place, of an attempt to correlate psychological with general biological data covering the widest field; and it issued in the principle of 'circular reaction' ('trial and error'; 'give and take') which he formulated as the groundwork upon which all the variations of the original life-act rest. In this way he accounted for the evolution of living organisms, individual development and social progress. Evolution, as a process, he thus viewed from a psychological angle as well as a biological one; and the problem as to whether or not there is any directive factor in its course was raised.

Baldwin's solution of this problem in its wider aspect—similar to that of Lloyd Morgan, which appeared at about the same time—relied neither upon a presumed inheritance of acquired characters nor upon any vitalistic determining agency. According to him, the spontaneous variations that occur in individual organisms are not handed on; but in each generation they act as factors which favour the developing function of the species, and thus allow the principle of natural selection full scope. Applied especially to the evolution of mind, in which Baldwin was more keenly interested, this theory becomes one of 'emergence'. The then prevailing view, that mental process should be explained by the quantitative method of analysis, by reduction of the whole to its constituent parts, destroyed the possibility of reaching any real genetic solution of the problem. Higher forms of mentality cannot be accounted for by mere reference to, or analysis into, lower ones. The properties of water—he takes the example from chemistry—cannot be explained by saying "water *is* (=) H_2O"; but only by saying "$H_2 + O$ *becomes* (<) water" (a view strongly reminiscent of the old theory of the 'mixt', and closely akin to, if not a foreshadowing of, that of configurationism). Accordingly, the proper position to adopt is that every true genetic development is irreversible; and that every phase in such a development indicates a new, higher, and heretofore unrealised, manifestation of what we call 'reality'.

These manifestations, so far as mind is concerned, may be studied in various ways: phylogenetically, anthropologically and ontogenetically; and all these methods of approach supplement one another. Accordingly, animal behaviour will form an objective subject of research, in which biogenetic results will be discovered; the stages of mental growth, as exhibited in all its phases from that of primitive peoples to the highest cultures, will be investigated, again objectively, by an examination not only of the mentality of existing peoples, but also of the languages, mores, laws, institutions and the like, to

which historically they have given rise; while from the psychogenetic point of view, the development of the individual mind from infancy to maturity will be the (largely subjective) complement by which the former results are interpreted and understood.

All this Baldwin dealt with in his several works on what he calls genetic logic, extending the use of the term 'logic' to signify the evolving processes of mental organisation as phases in one continuous movement. He recognised three distinguishable, though overlapping, stages in mental development, in which the same motives operate continuously. These are characterised as the pre-logical, the logical, and the super-logical; the principal signs of which are respectively sensory perception and memory, reasoning, and those hyper-rational functions which have been distinguished from reasoning, in the usual sense of the term, as 'reason'.

Baldwin made much of 'play' in this mental development; and found in it a motive ranging from the explorative and experimental play of children, through the tentative trials of hypotheses in logical reasoning, up to the idealisations of artistic production and mysticism on the highest plane. He also gave a high place to the genetic factor of social intercourse as a continuous motive of development which, on the principle of circular reaction, is to be found working at all levels, and issues, among other things, in the discursive processes of thought and language and the common heritage of an organic system of socially shared knowledge. In this connexion he emphasised the nature of the individual as a differentiation of a common social protoplasm; he is a social outcome rather than a social unit—a view again akin to, if not foreshadowing, configurationism.

Baldwin worked out the implications of these lines of thought in the direction of the life of feeling also, tracing the primitive 'interest' that lies at the basis of the whole, through its successive manifestations in organic, emotional and theoretical reactions, to its final response in the moral, æsthetic and religious sentiments, and dealing with many problems, such as those of value and æsthetic sympathy and immediacy, which present themselves in this field. From the foregoing it will readily be appreciated how thoroughly, in his many books and papers, he covered the ground he had mapped out for conquest at the beginning.

Despite the large output of his work and his closely reasoned geneticism, which have played no small part in the shaping of contemporary psychological thought, Baldwin is perhaps best known because of his "Dictionary of Psychology and Philosophy", which he produced, with the collaboration of more than sixty eminent thinkers, as an attempt to determine and stabilise a precise psychological terminology. More, perhaps, than any other science, psychology has suffered, and indeed still suffers, from ambiguities due to the fact that its technical terms are borrowed for the most part from ordinary language. It had been proposed to coin a terminology on the pattern of those of mathematics and chemistry, by the use of which it might be possible to avoid the theological and metaphysical connotations of such words as soul, cause, reason and the like, then in common use. Baldwin did not go so far as this; but he did produce a work of uncommon value for psychology, in which an exact usage is provided, together with its equivalent in other languages, for every term with which it deals. There are few teachers or students of psychology and philosophy who have not found this work indispensable. He has bequeathed also to psychology another invaluable legacy in the *Psychological Review*, which he founded with the veteran psychologist, James McKeen Cattell. This, together with the *Psychological Bulletin, Monograph Supplements*, and *Psychological Index*, which grew out of it, are likewise of the greatest value to the student.

It is difficult, at close range, to estimate the effect that the life-work of a man has upon the science that he represents; but it is safe to say that the future historians of psychology will see in James Mark Baldwin one of the outstanding representatives of the vital movements that are shaping the destinies of the science of psychology at the present day.

WE regret to announce the following deaths:

Sir E. A. Wallis Budge, formerly keeper of the Egyptian and Assyrian Department of the British Museum, on November 23, aged seventy-seven years.

Prof. Willem de Sitter, professor of astronomy in the University of Leyden, on November 20, aged sixty-two years.

News and Views

Anniversary Meeting of the Royal Society

IN connexion with the anniversary meeting of the Royal Society, on November 30, when the medals for the year were presented (NATURE, Nov. 10, p. 727) it may be recalled that this gathering one hundred years ago took place on December 1, in consequence of St. Andrew's Day falling upon a Sunday. The treasurer, Sir John William Lubbock, occupied the chair, the reason for this arising from a letter that he had received that day from H.R.H. the Duke of Sussex, president of the Society, stating that the condition of his eyesight forbade attendance. "I regret," the Duke wrote, "being deprived of the pleasure of conferring the medals this day, and particularly the one which has been so properly adjudged to you, for whom I profess the highest consideration." The customary anniversary address was not delivered. The Copley medal was allotted to Giovanni Antonio Plana, professor of astronomy and director of the observatory of the University of Turin, for his work entitled, "Théorie du Mouvement de la Lune" (3 vols. 4to., 1832). Elected a foreign member of the Society in 1827, Prof. Plana died at Turin in 1864. The recipients of the Royal medals were (1) John W.

Lubbock for his investigations on the tides, and (2) Charles Lyell for his work, "Principles of Geology". The grounds for the latter award were announced as: (a) the comprehensive view taken of the subject, and its philosophical spirit and dignity; (b) the important service rendered to science by specially directing the attention of geologists to effects produced by existing causes; (c) the author's admirable descriptions of many tertiary deposits; (d) the new mode of investigating tertiary deposits, which his labours have greatly contributed to introduce, namely, that of determining the relative proportions of extinct and still existing species, with the view of discovering the relative ages of distant and unconnected deposits. The Rumford medal was awarded to Prof. Macedonio Melloni, of Parma, for his researches and experiments on the diffusion of heat by radiation, and its relationship in lunar light. Melloni was director of the Meteorological Observatory, Mount Vesuvius, 1839–49, and became a foreign member of the Royal Society in 1839; he died in 1853.

British Association: Norwich Meeting

THE annual meeting of the British Association will be held next year in Norwich on September 4–11 under the presidency of Prof. W. W. Watts. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Dr. F. W. Aston; B (Chemistry), Prof. W. N. Haworth; C (Geology), Prof. G. Hickling; D (Zoology), Prof. F. Balfour Browne; E (Geography), Prof. F. Debenham; F (Economic Science and Statistics), Prof. J. G. Smith; G (Engineering), Mr. J. S. Wilson; H (Anthropology), Dr. Cyril Fox; I (Physiology), Prof. P. T. Herring; J (Psychology), Dr. Ll. Wynn Jones; K (Botany), Mr. F. T. Brooks; L (Educational Science), Dr. A. W. Pickard-Cambridge; M (Agriculture), Dr. J. A. Venn. The president of the Conference of Delegates of Corresponding Societies will be Prof. P. G. H. Boswell.

Dud Dudley and the Coal-Iron Industry

THROUGH the publication of his little work "Mettallum Martis", 1665, Dud Dudley, 1599–1684, a son of Edward Sutton, Lord Dudley, has long enjoyed a reputation as being a pioneer in the use of coal, instead of charcoal, as a fuel for smelting iron. Most early writers on industrial history accepted Dudley's writings at their face value without inquiring into their correctness. A proposal made some years ago to erect a monument to him at Dudley, however, led to a closer scrutiny of what he had written and the state of the iron industry at the time, with the result that many of his assertions have been found impossible of belief, and many of his claims to our admiration as an outstanding pioneer have to be rejected. A review of the whole question was given by Mr. R. A. Mott on November 21 in a paper read to the Newcomen Society at the Iron and Steel Institute, and in the subsequent discussion Mr. Mott's views found general acceptance. Dudley lived in stirring times and had many adventures, but his work as an iron master was done when he was a young man. That he did make iron there seems no need to question, but that he produced good quality iron with the use of coal has to be rejected. Mr. Mott's view is that, as a historian, Dudley's veracity has to be questioned, while as a man he was an opportunist, vain and boastful. A consideration of the technical basis of his claims shows that they were impossible of achievement. The *Transactions of the Newcomen Society* contain several valuable papers on the history of the iron industry and these, with that of Mr. Mott, should be studied by all interested in this phase of industrial history.

Cardiff Engineering Exhibition

THE thirteenth annual exhibition at Cardiff, held under the auspices of the South Wales Institute of Engineers, opened on November 21 and closes on December 1. The main object of these exhibitions is educational and also to encourage industry by bringing the manufacturers of machinery and plant into touch with the users. Whilst mining appliances were well represented, almost every branch of engineering activity has received attention. An outstanding feature of this year's display was an exhibition coal mine, equipped by the Coal Face Machinery Exhibitors' Association—an association which comprises nearly all the manufacturers of coal face machinery in Great Britain. It was installed not as an advertisement of any particular plant, but to show the possibilities of mechanisation at the coal face, and to keep mining engineers and others interested and informed of the most recent developments in this respect. The mine consists of a main roadway, a machine-mined heading and a longwall face, in which are placed examples of coal face machinery—longwall coal cutters and shearing machines, jigger and belt conveyors, dust filters and pneumatic drills. In the roadways and face, modern methods of supporting roof and sides are shown. The Department of Scientific and Industrial Research had a valuable exhibit illustrating some of the research activities of the National Physical Laboratory, the Fuel Research Station, the Chemical Research Laboratory and other scientific bodies. Thus, fatigue of metals, lubrication research, electric welding, alignment of machine tools, steel casting, microstructure of metals, corrosion of metals, hydrogenation of coal, smokeless fuel and industrial applications of X-ray analysis, were among the topics illustrated. An interesting exhibit consisted of turned objects made of some of the latest plastic materials derived from coal, and intended to display the artistic possibilities of such materials.

Competitive Trials of British Military Aircraft

THE periodical trials for the selection of new types of aircraft for R.A.F. equipment, now in progress, include some machines that have considerable technical interest. Two of the day and night fighters now being tested are monoplanes, designed and built by Messrs. Bristol and Vickers respectively. The British Service requirements for a fighter have hitherto put extreme manœuvrability in action first

in importance. In this respect the biplane is best, and at present all of the R.A.F. fighter machines are of this type. Some Continental nations consider superiority in speed of greater importance, allowing the pilot to engage or break off action at will. The clean lines and somewhat smaller head resistance of the monoplane give it the advantage in this case. The biplane has another point in its favour which must be considered when making comparisons. The wing structure can be built more sturdily for a given weight, and it is consequently safer for resisting the stresses developed in high velocity diving bombing, or in very small turns at high speeds when fighting. The new Bristol monoplane is fitted with a retractable undercarriage to eliminate the resistance of that part when in the air. The motion is carried out electrically, the pilot merely having to move a switch, an indicator on the dashboard telling him the position of the wheels. This type of undercarriage has not been used on R.A.F. standard equipment up to the present.

Heavy Water in Chemistry

AT the Friday evening discourse at the Royal Institution on November 23, Prof. M. Polanyi dealt with heavy water in chemistry. Heavy water has a density ten per cent greater than ordinary water. Its chemical composition is the same as that of ordinary water, two hydrogen atoms to one oxygen atom. Nor is there anything unusual about the oxygen atom. All the heaviness is due to the new kind of hydrogen discovered by Prof. H. C. Urey, which is contained in the heavy water. Its atomic weight is two instead of one. Heavy hydrogen atoms have the same structure as ordinary hydrogen atoms, only with a heavier nucleus. Such a pair of atoms would have the same chemical properties if the atoms were merely material particles. Atoms, however, are not only particles, but they are also waves: as waves, the two hydrogen atoms are different. The heavy one has a shorter wave-length. The chemical dissimilarity between the two hydrogens shows to what extent atoms behave as waves and not as particles.

THE chemical differences of ordinary and heavy water make it possible to extract heavy water from its natural dilution of one part in four thousand and prepare it in pure form. The preparation is still a very expensive operation, but methods can be outlined by which it might be considerably cheapened. Heavy hydrogen might then be used in the manufacturing of drugs and dyestuffs, if its properties should turn out to be useful, for example, if it shows greater stability than the products made of ordinary hydrogen. With heavy hydrogen, reactions can be discovered in which chemically nothing is changed, because all that happens is an interchange of hydrogen atoms. When part of the hydrogen atoms are 'labelled' by being of heavier sort, this interchange becomes apparent. Some well-known chemical reactions of hydrogen appear now as subordinate effects of this hitherto undiscovered interchange process. When, for example, hydrogen is added to benzene forming hydrobenzene, for every molecule adding on hydrogen there are a hundred molecules which react with hydrogen in the way of an interchange. It seems that hydrogenation may be just an occasional by-reaction of this main interchange process. Following this line, the atomic mechanism of hydrogenation can be worked out completely.

Preservation of Scenic Amenities

THE necessity for preserving the scenic amenities of the countryside is fortunately gaining more attention, and there is hope that some of the worst vandalism may be checked before it is too late. But the dangers of urban growth are still insistent, and to this topic Dr. Vaughan Cornish refers in an article in *Geography* of September on the scenic amenity of Great Britain. It is not only the growth of radial suburbs with their monotonous plans, but also the reconstruction of existing urban centres that needs to be controlled. The nineteenth century saw the spoliation of many picturesque market towns and beautiful cathedral cities and the growth of urban 'deserts' on the coalfields. Among the few examples of urban scenery from which Nature has not been expelled are the west end of London, the collegiate parts of Oxford and Cambridge and the precincts of most cathedrals. It is to be hoped that in schemes of reconstruction the dignified architecture of the eighteenth century, where it exists, will be preserved, while in the replacement of the closely packed streets of the Victorian era due regard should be paid to the possibility, with modern constructional materials, of accommodating the people on half the area by doubling the height of the houses and so leaving space for town gardening and afforestation. The conversion of every city into a garden city is the most important consideration in the replanning of towns, and this must entail the abandonment of formal lines which are so tiring to the eye.

Recent Acquisitions at the Natural History Museum

AMONG the recent acquisitions at the British Museum (Natural History), the Department of Zoology has received as a donation from the Rowland Ward Trustees an exceptionally fine mounted head of the Tian-Shan wapiti, and from Sir Arnold Hodson, Governor of the Gold Coast, a further skull of the so-called dwarf elephant, or 'Sumbi', from the Gola Forest, Sierra Leone. This specimen is a young individual of the forest elephant. The horns of a white rhinoceros from the Belgian Congo have been presented by Mr. Stanley C. Tomkins. This gift is of special interest in that the Museum already possesses the skull to which these horns belong. One hundred and fifty birds of 76 different kinds collected in the dry thorn bush region of the West Usambara Mountains, Tanganyika Territory, have been purchased, and also an interesting collection of more than 200 birds from Serbia and Macedonia. Extensive collections of insects made during the summer months of 1931, 1932 and 1933 by members of the staff of the Department of Entomology in the Scottish Highlands are beginning at last to yield interesting results. More than 7,000 specimens were obtained and added to the collections, and among them so

far more than 50 species have been recognised that have not previously been recorded from Great Britain, including at least 13 new to science. The particular aim of the collecting undertaken was the study of the fauna occurring in association with the relict arctic-alpine flora peculiar to elevations above 2,500 ft. In one group alone, consisting of the saw-flies, four species new to science, and 13 new to Great Britain were obtained, with a total of 18 species peculiar to the region specially investigated.

Botany at the Natural History Museum

MR. J. D. SNOWDEN has presented to the Department of Botany his herbarium of 2,300 plants. During his period of service as agricultural officer in Uganda, Mr. Snowden was an enthusiastic botanical collector with great opportunities of which he made full use. His collections rank, both in number and quality, among the best from the Protectorate, and include many plants discovered by himself. The specimens presented to the Museum formed his own personal set. Some of the plants were collected in the little-known Acholi Hills in the south of the Sudan, but the great majority came from Uganda, particularly from Mount Elgon, the flora of which—like that of the other great African mountains—is of exceptional interest. As an agricultural officer, Mr. Snowden knew just what was required, and his material is accompanied by adequate notes. He paid special attention to grasses, a group in which his name is commemorated by the genus *Snowdenia*.

SIR J. L. HANHAM, who accompanied Mr. J. M. Wordie's recent arctic expedition, made a collection of plants from West Greenland (500 numbers) and Baffin Land (200 numbers), together with a few lichens and mosses. Plants in the arctic are well known to be shy flowerers, and this collection contains exceptionally good specimens ; they are unusually well dried, whereas so many arctic collections have suffered much from mould and mildew owing to the great humidity of the atmosphere in high latitudes. As a result, this collection is a valuable one apart from the fact that it has been made in little-known regions. Mrs. E. M. Day has presented the paintings of larger fungi made by her late husband. They number 1,400. Most of them have been examined by eminent mycologists or have been drawn from specimens named by them. An interesting fern herbarium of about 500 specimens from Trinidad has been presented by Archdeacon A. Hombersly. The herbarium is in very good condition and is of particular value as the donor used his collection as the basis of an account of the ferns of Trinidad which is now being prepared for Press. Mr. E. Heron-Allen has presented a copy of the valuable first edition of the "Thesaurus Evonymi Philiatri de remediis secretis", by Conrad Gesner, 1557. This is a rare book, particularly in the first edition. It makes an interesting addition to the collection of herbals in the Department of Botany.

Die Physik

THE quarterly journal *Die Physik in Regelmässigen Berichten*, which is sponsored by the German Society for Technical Physics, has completed its second year. As the full title implies, its contents are mainly surveys of larger or smaller fields of physics, the average length of an article being about 15 pages. The thirteen subjects dealt with range widely, and include hygrometry, acoustics, medical physics, corpuscular radiations and general quantum theory, the balance between the old and the new physics being carefully maintained. It is presumably the intention to give further surveys with the same titles, as the subjects develop, since the title of each article is followed by the numeral I. The reviews appear very thorough, considering the space available, and are all by acknowledged experts in their subjects. Thus F. Henning writes on thermal apparatus, M. Pirani on illuminants and illumination, W. O. Schumann on dielectrics and G. Wentzel on quantum theory and wave mechanics.

A FEATURE of the publication is the method of citing references to investigations mentioned in the surveys. Whenever possible, the volume and page number of the abstract in the *Physikalischen Berichte* is given, without more detailed reference, a note at the end of every article explaining that this has been done. Additional references are collected together at the end of the survey. An innovation which seems to have little to recommend it is that of numbering the pages of each survey independently, and printing this page number on the top corner of the leaf. A second set of page numbers running serially through the volume is also provided, but is in a less conspicuous position, at the bottom corner of the leaf. The periodical is published by J. A. Barth of Leipzig, and the annual subscription (post free) is 24.60 gold marks.

A New Modified Bunsen Burner

THE Bunsen burner is one of those simple and ingenious contrivances that could only have emanated from the brain of a practical genius. Unlike some of his successors to-day, Bunsen was never a *Schreibtisch-Chemiker* ; flouting speculative hypotheses, he excelled in practical work of many kinds, and in devising his celebrated burner he created for himself a memorial that may well outlast his fame as an analytical investigator. Generations of chemists and physicists come, use his burner, and go ; yet the principle of it stands fast. From time to time a useful modification, for example, the Meker and the Teclu, arises, and the latest, which has recently been marketed by Messrs. Amal Ltd., of Birmingham, appears to belong to this category. In this burner, a very sensitive control of the gas flow is obtained by means of a needle-valve, inserted in the orifice of the jet, which is capable of very fine adjustment by an external screw. Air-regulation is unnecessary, and the flame can be reduced almost to invisibility, by means of the needle-valve, without flashing back. As in the Meker burner, the combustion-head is perforated with many small holes, so that the flame consists of a cluster of perfectly aerated small cones. Attached to the base is an insulated hooked strip of metal for use as a holder should the burner become

hot. The Amal burner is supplied in several sizes, that for ordinary use measuring 5½ in. high and one inch across the head, and costing 12*s*. 6*d*.

Value of Anti-Diphtheritic Serum Treatment

THE autumn issue of the *Fight against Disease* (22, No. 4), the quarterly journal of the Research Defence Society, contains an article by Sir Leonard Rogers showing the reduction in the suffering and the deaths of children from diphtheria during the last forty years consequent upon the use of anti-diphtheritic serum treatment. He points out that the *case mortality*, the most scientific test of the value of treatment, from diphtheria in the hospitals of the Metropolitan Asylums Board, has steadily fallen every year from a percentage of 30·4 in 1890–93 before serum was used, to 9·0 in 1905, 7·4 in 1910, and less than 4·0 in 1933, following the treatment of the disease with the serum. More striking still is the fall in mortality for laryngeal cases, from 62 per cent in 1894 to 11·7 in 1910. The value of the serum treatment is even more conclusively shown by its remarkable efficacy in the early stages of the disease, as compared with its comparative failure when given after the fourth day of the disease, when the toxæmia of the disease is fully developed, in accordance with what animal experiments had indicated would be the case. The case mortality per cent when treatment is commenced on the first day of the disease is only 1·6, on the second day it is 7·9, and on the third 17·2. As Sir Charles Martin has pointed out, "If the antitoxin (serum) were a remedy of no value, whether it was administered on the first or on the fifth day of the disease would be immaterial". Clinical evidence is no less conclusive: many doctors still living can testify to the horrors of diphtheria in young children in the pre-serum days. This is now all changed, and the young diphtheria patient if treated early with serum will rarely succumb. Sir Leonard Rogers estimates that had the pre-serum mortality from diphtheria continued since 1911, there would have been 250,000 more deaths from diphtheria than were actually recorded.

Television in the United States

THE October issue of *Electronics* contains an illustrated article surveying the principal systems of television which are undergoing development in the United States of America. Of the six systems reviewed, four employ a cathode ray oscillograph type of tube for both transmission and reception; while the other two employ mechanical-optical systems comprising a vibrating mirror or a rotating mirrored disc, in conjunction with a photoelectric cell for transmission and a Kerr cell for reception. All the methods are capable of transmitting scenes photographed on the standard size of cinematograph film; most of them are also suitable for the transmission of studio scenes, while some can be successfully operated on outdoor scenic material. The number of scanning lines into which the picture is dissected for transmission varies from 60 to 400, while an average value of 240 lines is very popular. The transmission of such a picture at the standard cinematograph rate of 24 per second requires a communication channel of the order of 1,000 kc./sec., as compared with the space of 9 or 10 kc./sec. permitted in modern sound broadcasting. Such a large band-width is considered to be essential for satisfactory picture reproduction, and this technical limitation presents one of the most serious problems to the television worker. It requires transmitting and receiving circuits of great complexity and high cost, and it would appear to limit the available waveband for broadcast television to the ultra-short region below 10 metres. The article referred to discusses briefly the prospects of the commercial application of television in America, and expresses the opinion that in addition to the technical problems, there are other difficulties of a financial nature involved in the provision of a television programme service throughout the country.

General Štefánik

GENERAL MILAN R. ŠTEFÁNIK had the distinction of being almost the only Slovak man of science to attain any eminence since the time of Komenský (1592–1670). He studied in Paris, and before the War became secretary of the Observatory at Meudon and went on several French scientific missions. During the War, he was an air force officer in France, Serbia and Italy before becoming Czechoslovak Minister of National Defence in 1918. He was unfortunately killed when his aeroplane crashed near Bratislava as he was returning home in May 1919. Some account of his work has now been placed on record in a book recently published by Eos, Bratislava. The author, Mr. Ferdinand Písecky, was closely associated with General Štefánik during his missions in Russia and the United States, and the book is a valuable addition to Czechoslovak literature; although it deals primarily with Štefánik's War career and his political activities, occasional reference is made to his scientific work.

Eskimo Studies

A PRIZE of a gold medal and a thousand crowns has been offered by the Royal Academy of Sciences and Letters of Denmark for a study of Eskimo origins. In the statement of the conditions upon which this prize is offered for competition, it is pointed out that there are two main opposing views on the origins and ethnological affinities of the Eskimo. The older of the two theories to which reference is made derives from the views put forward by the Danish authority, J. H. Rink, in 1871, that the Eskimo were of close affinity to the Indians of North America and had originated in a comparatively restricted centre in the interior of the American continent, from which they had migrated to Alaska and afterwards spread across the northern area as far as Greenland. Later, the place of origin was defined more precisely as in the neighbourhood of Hudson Bay. The alternative theory, which it may be said is that now more generally held, is that the Eskimo, while showing affinities with the Indians,

are derivative from certain peoples of Eastern Asia, but there is considerable difference of opinion on many points. Dissertations have, therefore, been invited in which an attempt is to be made to resolve the problem of the origin of the ancient Eskimo civilisation in the light of every available class of evidence, physical character, culture, linguistic, folk-lore and the like. The result of the competition will be announced in February next.

Annual Radiological Congress

THE Annual Congress of the British Institute of Radiology (incorporated with the Röntgen Society) will be held in the Central Hall, Westminster, London, S.W.1, on December 5–7. The Congress will be officially opened on December 5 by Sir Humphry Rolleston. The seventeenth Silvanus Thompson Memorial Lecture will be delivered by Dr. H. H. Berg on "The Digestive Mucosa" on December 6, and the fifteenth Mackenzie Davidson Memorial Lecture by Sir William Bragg on "X-Rays and the Coarse Structure of Materials" on December 7. In connexion with the Congress, an exhibition of X-ray apparatus will be held at the Central Hall. Further information can be obtained from the Organising Secretary, 47 Red Lion Street, High Holborn, London, W.C.1.

Ramsay Memorial Fellowships

THE following Ramsay Memorial fellowships for the year 1934–35 have been awarded: Mr. G. C. Hampson, a British fellowship of £300, tenable for two years, at the University of Oxford; Mr. George Bryce, a Glasgow fellowship of £300, tenable for two years, at the University of Cambridge; M. Berton, a French fellowship, at the Imperial College of Science and Technology, London; Dr. Charles Haenny, a Swiss fellowship of £300, at Birkbeck College, London; Prof. G. Semerano, an Italian fellowship of £300, at the Imperial College of Science and Technology, London; Dr. M. G. van ter Horst, a Netherland fellowship of £300, at the University of Cambridge. The following fellowships have been renewed for the same year: Dr. C. Kawassiades (Greek fellow), Ramsay Memorial Laboratory of Chemical Engineering, University College, London; Dr. Ikutaro Sawai (Japanese fellow), University College, London; Dr. A. G. Winn (British fellow), University College, London.

Announcements

THE Buchan Prize of the Royal Meteorological Society for 1935 has been awarded to Dr. F. J. W. Whipple, for papers contributed by him to the *Quarterly Journal* of the Society during the years 1929–33.

PROF. ERNST HERZFELD, director of antiquities, Persia, will deliver the Schweich lectures on biblical archæology at the British Academy on December 3, 5 and 7. The subject of Prof. Herzfeld's lectures will be "The Archæological History of Iran".

PROF. W. L. BRAGG, Langworthy professor of physics in the University of Manchester, will deliver the Christmas Lectures adapted to a juvenile audience at the Royal Institution on December 27, 29 and January 1, 3, 5 and 8, at 3 p.m. The subject of Prof. Bragg's lectures will be "Electricity". Further information can be obtained from the Secretary, Royal Institution, 21 Albemarle Street, London, W.1.

THE Meldola Medal, the gift of the Society of Maccabæans, is awarded annually by the Council of the Institute of Chemistry to the British chemist under thirty years of age whose published chemical work shows the most promise. The next award will be made in January 1935, and the Council would be glad to have attention directed, by December 31, to work of the character indicated. Communications should be addressed to the Registrar, Institute of Chemistry of Great Britain and Ireland, 30 Russell Square, London, W.C.1.

ARRANGEMENTS have now been completed in connexion with the symposium organised by the British Section of the International Society of Leather Trades' Chemists on "Technical Aspects of Emulsions" to be held at University College, Gower Street, W.C.1, on December 7 (not, as originally announced, at the Royal Society of Arts), at 10 a.m.–6 p.m., under the chairmanship of Prof. F. G. Donnan. The symposium has attracted considerable attention in chemical, industrial and medical circles, and a large attendance is assured. Members and others desiring to attend should notify Dr. C. H. Spiers at the offices of the Society, 17 Market Street, London, S.E.1. The papers read at the meeting are to be published in bound form, which will be available shortly after the symposium.

MR. ARCHIBALD THORBURN, the well-known bird artist, has again presented the Royal Society for the Protection of Birds with one of his beautiful pictures for its special Christmas greeting card. The painting is of a pair of longtailed tits poised on a spray of golden gorse. Copies may be obtained from the Royal Society for the Protection of Birds, 82 Victoria Street, London, S.W.1, for 4*s*. 7*d*. a dozen, inclusive of envelopes and postage.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary assistant lecturer in zoology and geology at University College, Southampton—The Registrar (Dec. 8). A museum assistant at the Woolwich Borough Museum—The Town Clerk, Town Hall, Woolwich (Dec. 10). Two junior assistants at the Museum and Art Gallery, Birmingham—The Keeper (Dec. 11). A lecturer in physics and mathematics at the Northampton Polytechnic Institute, St. John Street, London, E.C.1—The Principal (Dec. 12). A lecturer in mechanical engineering at the University of Capetown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London (Dec. 19). A guide lecturer in the British Museum (Natural History)—The Secretary, British Museum (Natural History), London, S.W.7 (Dec. 31).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 854.]

Direct Introduction of Deuterium into Benzene

THE interchange of hydrogen between benzene and 90 per cent sulphuric acid reported by Ingold, Raisin and Wilson[1] appears to us to be a special case of the following general principle, by which interchange with the hydrogen of unsaturated compounds may be effected.

The equilibrium between an ethylene derivative and the alcohol resulting by addition of water to the double bond has been studied recently by Stanley, Youell and Dymock[2]. The dehydration is endothermic (by approximately 9,000 cal.), and hence, whenever the ethenoid compound and water are both present in appreciable concentrations, an equilibrium will be established with the formation of a finite quantity of alcohol.

Remembering that catalysts of dehydration must also accelerate the reverse process, we conclude that when a system consisting of an ethenoid compound and D_2O is brought into contact with a dehydrating catalyst, a trace of alcohol will be formed, which will, in its turn, immediately decompose with the reformation of the unsaturated compound. Owing to the approximate chemical equivalence of H and D, the water molecule eliminated during the course of this decomposition would appear to have an equal chance of being either HDO or D_2O. In the former case, an interchange of one of the original H atoms attached to an unsaturated carbon atom has occurred. The mechanism of the process can be depicted as follows:

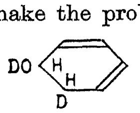
$$-CH=CH-+D_2O=-\underset{OD}{CH}-\underset{D}{CH}- = \begin{array}{l}-CH=CH-+D_2O\\ \quad\text{or}\\ -CH=CD-+HOD.\end{array}$$

After such a process of transitory addition of water, the ethenoid bond would necessarily be left in the more stable (*cis* or *trans*) steric form. If it had originally been in an unstable form, it would be converted into the stable one.

Furthermore, the process might result in a migration of the double bond as in the following scheme:

$$-CH=CH-CH_2-+H_2O=-CH-\underset{OH}{CH}-CH_2-=$$
$$-CH_2-CH=CH-+H_2O.$$

The same considerations would apply to the transitory addition of hydrogen halides to an ethylene linkage. Again, the occurrence of such transitory additions can be predicted, if catalysts by which the *splitting off* of the hydrogen halide with concomitant formation of a double bond is effected are present. Hence, in the presence of such catalysts, a hydrogen halide will act on an ethenoid double bond in three different ways: (*a*) hydrogen replacement; (*b*) *cis-trans-* inversion; (*c*) wandering of the double bond.

The interchange reported by Ingold and his coworkers comes under the principle enunciated here, if we make the probable assumption that the compound  is readily dehydrated by 90 per cent sulphuric acid to form benzene.

The strictness of the above conclusions depends on the condition that the splitting off of water or hydrogen halide from the alcohol or alkyl halide should not be affected by the presence of the reaction products in those concentrations in which they are to be applied in the interchange reaction. In this case—and assuming again equivalence of H and D—we can calculate the velocity constant k of exchange reaction from the equilibrium constant K, and the first order velocity constant k' of decomposition in the usual way: $k=k'/K$.

We consider the following two observations of an interchange of hydrogen atoms between ethylene and 96 per cent H_2SO_4 as a confirmation of our principle:

96 per cent H_2SO_4		Quantity of C_2H_4 absorbed	Ethylene recovered	
Quantity	per cent D		Quantity	per cent D
5·1 gm.	9 1	69 c.c.	28 c.c.	5·2
4·9 gm.	9·4	69 c.c.	27 c.c.	5·0

In the first case, the ethylene absorbed was left overnight in solution; in the second case it was removed, by heating the solution *in vacuo*, immediately after absorption had been completed.

J. HORIUTI.
M. POLANYI.

Department of Chemistry,
University,
Manchester.

[1] NATURE, **134**, 734, Nov. 10, 1934.
[2] *J. Soc. Chem. Ind.*, **53**, 625; 1934.

PROF. POLANYI and Dr. Horiuti have kindly shown us the manuscript of their letter referring to our observation of hydrogen exchange between aqueous sulphuric acid and benzene. We should like to indicate our point of view in the matter.

Whilst we concur in the suggestion that hydrogen exchange in unsaturated compounds through the action of reagents such as aqueous sulphuric acid would often be caused by the addition and elimination of some simple molecule such as water,

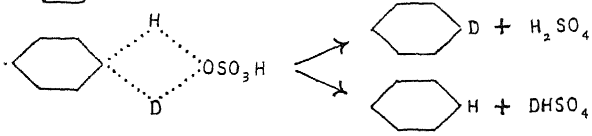
$$.CH:CH.+D_2O\rightarrow .CH(OD).CHD.\rightarrow .CH:CH.\ \text{or}\ .CH:CD.,$$

we would not apply this type of theory to exchange in benzene or in aromatic compounds generally. In its application to the aromatic case, this theory seems to us to be a special case of the two-point addition theories of aromatic substitution; these have now been abandoned as they give but a poor account of orientation and are inconsistent with the non-parallel relation between orientation and velocity[1].

We regard hydrogen exchange in benzene derivatives as a special application of our views on aromatic substitution by electrophilic reagents[2], and we expect to prove that the exchange obeys the ordinary orientation laws. Our theory involves one-point addition: aromatic substitution differs from substitution in saturated compounds mainly in the circumstance that the polarisability of the aromatic system is available to assist the formation of the

additional partial bond in the critical complex. The exchange we described[3] involves the polarisations

 and D→OSO_3H, and may be formulated:



This mechanism is analogous to that originally illustrated by Ingold and Ingold for nitration[4].

C. K. INGOLD.
C. G. RAISIN.
C. L. WILSON.
University College,
London.

[1] Ingold and Shaw, *J. Chem. Soc.*, 2918; 1929.
[2] Ingold and Ingold, *J. Chem. Soc.*, 1310; 1926. Ingold, *Rec. Trav. Chim.*, **48**, 797; 1929. *J. Chem. Soc.*, 1120; 1933. *Chem. Rev.* (in press).
[3] NATURE, **134**, 734, Nov. 10, 1934.
[4] *loc. cit.*

Spectra and Latent Energy in Flame Gases

PROF. W. T. DAVID in the first paragraph of his letter under this title[1] makes two points about the afterglow in the gases from flames or explosive reactions; the first that the temperatures determined by the sodium flame reversal method are too high, compared presumably with the platinum resistance method, the second that 'long-lived' luminous products account for a considerable proportion of the heat of combustion, while further on he mentions 15 per cent.

The sodium reversal method demands that the atoms of sodium are in thermodynamic equilibrium with the gas, and this is not necessarily the case if a small percentage of metastable excited molecules are present which are capable of communicating energy more easily to the sodium atoms[2]. As regards the second point, the energy associated with the change of metastable CO_2 to the normal state seems to be of the order of at least 80 cal. per mol., as indicated by the photographs of the diffuse banded spectra[3] and probably higher[4]. Since the heat of combustion of CO is only 67·6 cal. per mol., Prof. David's value for the proportion of the heat of combustion latent in the metastable molecules would indicate that 13 per cent of the molecules were in such a state, and if these all returned to the normal state by emitting light, the efficiency of illumination by the CO flame would be far greater than experience indicates. As one of us wrote in the discussion of one of Prof. David's papers, he is possibly correct in ascribing the luminosity or afterglow to metastable molecules, but the amount of energy which he connects with them seems altogether unreasonable.

A. EGERTON.
A. R. UBBELOHDE.
Thermodynamics Dept.,
Clarendon Laboratory,
Oxford.

[1] NATURE, **134**, 663, Oct. 27, 1934.
[2] cf. Ubbelohde, *J. Chem. Soc.*, 977; 1933.
[3] Fowler and Gaydon, *Proc. Roy. Soc.*, A, **142**, 362; 1933.
[4] cf. Goodeve, *Trans. Faraday Soc.*, **30**, 63; 1933.

MESSRS. EGERTON and Ubbelohde appear to agree that flame temperatures determined by the sodium line reversal method may be too high. The evidence that they are, in general, too high, seems to me to be overwhelming and has been recently reviewed[1]. They are not only in general too high (by some hundreds of degrees centigrade) when compared with temperatures determined by the platinum resistance method, but sometimes also when compared with the ideal calculated temperatures.

In one instance only, so far as our experiments have gone, are the platinum and sodium temperatures in approximate agreement, namely, for flames resulting from the combustion of a 'correct' CO-air mixture. For this mixture burning at atmospheric pressure the sodium flame temperatures determined by Loomis and Perrot[2] and by Ellis and Morgan[3] are 1900° C. and 1930° C. The maximum value determined by Griffiths and Awbery[4] by the same method is considerably lower, about 1780° C. Our platinum-rhodium wire resistance measurements yields for the same mixture burning at the same pressure a temperature of approximately 1870° C. (slightly extrapolated from a series of experiments on 'weak' and 'over-rich' mixtures[5]).

Confining attention to this mixture, in regard to which the approximate flame temperature can scarcely be in doubt, calculation shows that less than 80 per cent of the heat of combustion has been released in the flame gases, and, as the platinum wire experiments show that a state of equilibrium has been reached[6], there would seem to be a clear case for postulating a long-lived latent energy within the flame gases amounting to more than 20 per cent of the heat of combustion.

Messrs. Egerton and Ubbelohde think it likely that the afterglow of the flame gases is to be attributed to metastable molecules, but consider it unreasonable to suggest that the whole of this large amount of latent energy is associated with them. They make a strong case for this view, arguing upon the assumptions that carbon dioxide can possess only one metastable state and that the normal state can only be reached by the emission of light. But our knowledge of the metastable states of triatomic molecules is at present at a very elementary stage, and exclusive quantitative criticism would seem to be a little premature. It may, therefore, be worth while keeping metastability in mind as a possible seat of the long-lived latent energy, though, as stated in my previous letter, another explanation would appear to be possible.

Whatever may be the explanation, it seems certain that there exists in flame gases a long-lived latent energy, which is large in amount in flames and relatively small in amount in large vessel explosions. The object of my letter was to point out a probable connexion with Prof. Bone's spectrograms for flames and explosions.

W. T. DAVID.
Engineering Department,
University,
Leeds.
Nov. 9.

[1] "The Sodium Line Reversal Method of Determining Flame Temperatures", *Engineering*, Nov. 2, 1934.
[2] *Ind. and Eng. Chem.*, Oct. 1928, 1007.
[3] *Trans. Faraday Soc.*, 28, 826; 1932.
[4] *Proc. Roy. Soc.*, A, **123**, 401; 1929.
[5] *Phil. Mag.*, **17**, 176; 1934.
[6] *Phil. Mag.*, **17**, 174; 1934. **18**, 230; 1934.

Chemical Reactivity and Absorption of Light

IN recent publications[1], it has been shown that the absorption of light by a mixture of two reacting substances is greater than the absorptions of the reacting substances considered separately. Thus the absorption in the visible and ultra-violet regions by a mixture of $N/400$ aqueous iodine and $2N$ potassium oxalate is much greater than the light absorption by $N/800$ aqueous iodine and N potassium oxalate taken

separately. This relation has been observed with numerous chemical reactions taking place in aqueous solutions.

Recently, we have measured the absorption of light in the visible region of hydrogen, methyl and ethyl alcohol vapours, chlorine and bromine in the gaseous state separately and in mixtures of one reducing agent and one oxidising agent, by a Hilger quartz spectrograph E_1, having an arc of copper and iron electrodes as the light source. The absorption chamber consisted of a glass tube 80 cm. long and 2·5 cm. in diameter with quartz windows. The time of exposure was one minute.

The accompanying results were obtained :—

	Partial pressures (cm. Hg)	Absorption limit
Hydrogen	40 cm.	No absorption
Ethyl alcohol (vapour)	40 cm.	No absorption
Methyl alcohol (vapour)	40 cm.	No absorption
Chlorine	20 cm.	3705–2824 A.
Bromine	20 cm.	4164–5105 A.
Hydrogen + Chlorine	40 cm. H_2 + 20 cm. Cl_2	3770–2824 A.
Hydrogen + Bromine	40 cm. H_2 + 20 cm. Br_2	4140–5105 A.
Ethyl alcohol + Bromine	40 cm. C_2H_5OH + 20 cm. Br_2	4100–5105 A.
Methyl alcohol + Bromine	40 cm. CH_3OH + 20 cm. Br_2	4125–5105 A.

From the results, it is observed that the absorption by mixtures of reacting substances in the gaseous state is greater than the absorption by the ingredients considered separately. It is interesting to note that we have found no increased absorption when chlorine, bromine and hydrogen are dried by passing through concentrated sulphuric acid or phosphorus pentoxide. It is well-known from the researches of H. B. Baker[2] and others that desiccation decreases chemical reactivity. It seems, therefore, that increased absorption of light is a measure of the reactivity of a system. We are of opinion that the increased absorption of light by mixtures is due to the weakening of the binding forces of the molecules. Thus, the presence of hydrogen or any other reducing agent weakens the binding forces of the halogen molecules, with the result that the molecules become reactive and show increased absorption.

The observations of Weigert and Kellermann[3] on fog formation when hydrogen is added to chlorine, and the increased absorption of light observed by Henri and Landau[4], J. C. Ghosh and collaborators[5] with mixtures of organic acids and ferric and mercuric chlorides and uranyl nitrate solutions, and the observations of Fajans and Karagunis[6] that the absorption by silver halides containing adsorbed silver is greater than that of silver halide alone or of silver halide containing adsorbed halogen, have been explained from the point of view that chemical reactivity is associated with increased absorption of light. It is well known that silver halides containing adsorbed silver are more readily decomposed in light than silver halides containing adsorbed halogen.

N. R. DHAR.
P. N. BHARGAVA.

Chemical Laboratory,
University of Allahabad.
Oct. 4.

[1] Dhar and Bhattacharya, *J. Indian Chem. Soc.*, **11**, 33, 311 ; 1934. Dhar and Kar, *ibid.*, **11**, 629 ; 1934.
[2] H. B. Baker, *J. Chem. Soc.*, **65**, 611 ; 1894 : **81**, 400 ; 1902.
[3] Weigert and Kellermann, *Z. phys. Chem.*, **107**, 1 ; 1923.
[4] Henri and Landau, *C.R.*, **158**, 181 ; 1913.
[5] J. C. Ghosh and collaborators, *J. Indian Chem. Soc.*, **4**, 353 ; 1927 : **5**, 191, 569 ; 1928.
[6] Fajans and Karagunis, *Z. phys. Chem.*, (B), **5**, 385 ; 1929.

The Crystal Structure of $Hg(NH_3)_2Cl_2$

THE X-ray photograph of this cubic crystal powder shows an unexpected small number of interference lines (Fig. 1). The unit cell of dimensions (4·06 A.)[3] contains but *half* a molecule. A similar fact, $n = \frac{1}{3}$, was found in the case of $CdBr_2$[1]; here the small pseudoperiod as indicated by the X-rays was explained by a mode of compilation of the atomic layers, in which the CdI_2 and the $CdCl_2$ type follow in haphazard succession.

Putting

NH_3 on 000
Cl on $\frac{1}{2}\frac{1}{2}\frac{1}{2}$
$\frac{1}{2}$ Hg distributed without order over the edge centres :
$\frac{1}{6}$ Hg on $\frac{1}{2}00$, $0\frac{1}{2}0$ and $00\frac{1}{2}$,

the puzzling diagram can be explained as follows :

hkl	Intensity	*S* calculated
ppp	strong	$\frac{1}{2} F_{Hg} + F_{Cl} + F_{NH_3}$
iii	strong	$\frac{1}{2} F_{Hg} + F_{Cl} - F_{NH_3}$
ppi	absent	$\frac{1}{6} F_{Hg} - F_{Cl} + F_{NH_3}$
pii	absent	$\frac{1}{6} F_{Hg} - F_{Cl} - F_{NH_3}$

(p = even, i = odd).

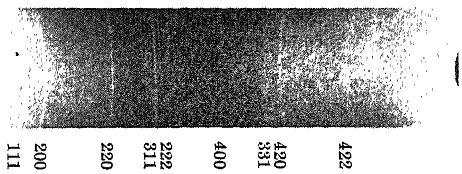


FIG. 1. X-ray photograph (copper K-rays) of $Hg(NH_3)_2Cl_2$.

The structure was proved by substituting Cl by Br. The diagram of $Hg(NH_3)_2Br_2$ shows close resemblance to that of the chloride, except that the reflections of mixed indices appear with weak intensity (a = 4·21 A.). The intensity ratios in and between both reflection groups (mixed and unmixed indices respectively) are calculated in the right order on the basis of the structure model given.

A haphazard distribution of n atoms over a more than n-fold position has been deduced for $\alpha - Ag_2HgI_4$[2] and for $\alpha - AgI$[3] from the analysis of their diffraction intensities. In the present case, such a complication is most obvious as it reduces the Röntgen period to a value incompatible with the extension of a molecule.

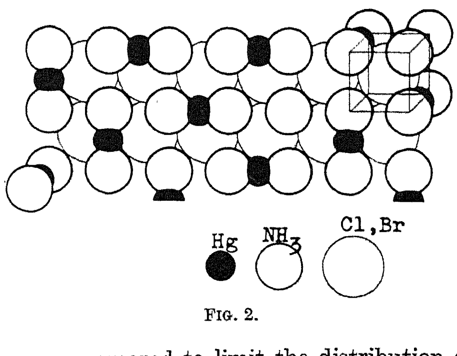


FIG. 2.

If we are prepared to limit the distribution of the Hg ions by the condition that each NH_3 group should be in contact with *one* Hg only, then the

structure shows linear complexes $NH_3 - Hg - NH_3$ orientated along the three axes in irregular succession (Fig. 2).

A detailed account will appear in the *Zeitschrift für Kristallographie.*

J. M. BIJVOET.
C. H. MACGILLAVRY.

Laboratorium voor kristallografie
der Universiteit, Amsterdam.
Oct. 18.

[1] J. M. Bijvoet and W. Nieuwenkamp, *Z. Krist.*, **86**, 466; 1933.
[2] J. A. A. Ketelaar, *Z. Krist.*, **87**, 436; 1934.
[3] L. W. Strock, *Z. phys. Chem.*, B, **25**, 441; 1934.

Effect of Dispersion and of Lattice Distortion on the Atomic Scattering Factor of Copper for X-Rays

NUMEROUS investigations of the effect of dispersion on atomic scattering factors for X-rays have shown that, when the wave-length of the X-radiation is comparable with the wave-length corresponding to an absorption edge of the scattering atom, the value of the scattering factor f is lowered by an amount Δf depending on the proximity of the incident wave-length to the absorption edge; the effect is in many respects similar to 'anomalous' dispersion in the optical region. The agreement between experiment and theory regarding the magnitude of Δf has been very rough and, as Williams[1] has pointed out, "the results obtained by different observers do not show a consistent departure from the calculated results". It is clear therefore that the blame cannot be laid wholly on assumptions involved in the calculations.

It seemed to us that a possible explanation might be based on the fact that nearly all experiments have been carried out with powdered crystals of iron and copper, and it is well known that metallic crystals are very easily deformed; different degrees of deformation in the specimens used by different investigators might be the cause of the variations in the final results. We have, therefore, tested this possibility very carefully for the case of copper $K\alpha$ radiation reflected from powdered copper crystals; the wave-length of the radiation is 1·539 A. and the wave-length for the K absorption edge of copper is 1·379 A.

For the (220) spectrum at room temperature we obtain a value 11·7 for the atomic scattering factor. Very finely divided powder was used, which was prepared by precipitation from copper sulphate solution by the addition of zinc; great care was taken in the preparation to avoid deforming the crystals in any way. Very fine copper powder filed from a chill-cast rod (prepared from electrolytic copper estimated to be at least 99·95 per cent pure) was compared with the precipitated copper by a direct method; this gave a value 11·0 for the same spectrum. A microphotographic investigation showed that the filed particles were considerably smaller than the individual grains in the copper rod, so that the filing process must have treated the separate crystals in a fairly drastic manner. We have also investigated particles filed from a hard drawn copper wire; in this case the particles were larger than the grain size of the copper, so that the filing process would tend to rip apart groups of small crystals. This led to a value of 11·4 for the (220) spectrum.

These differences between the atomic scattering factors for different specimens of copper are much larger than the experimental errors; they have been determined by a direct method and are confirmed by the fact that for higher order spectra the differences are considerably greater. We give the results for the (220) spectrum because this has always been taken as the 'standard' spectrum in other investigations of this type.

The value 11·7 for precipitated copper, which presumably is strain-free, when corrected for heat motion in the lattice, becomes 12·7, while the corresponding figure for wave-lengths outside the dispersion region on the small wave-length side is 16·0, so that the lowering of the scattering factor due to dispersion is 3·3. This is to be compared with 2·3 calculated by Williams and 2·5 calculated from data given by Hönl[2].

The results of these experiments, which we hope will soon be published in detail, show that distortions in a metal reduce the value of the atomic scattering factor, and this may be one cause contributing to the present differences between the results of different observers.

G. W. BRINDLEY.
F. W. SPIERS.

Physics Laboratories,
University of Leeds.
Oct. 15.

[1] E. J. Williams, *Proc. Roy. Soc.*, A., **143**, 358; 1934.
[2] H. Hönl, *Ann. Phys.*, **18**, 625; 1933.

Rotational Raman Scattering in Benzene Vapour

A THEORY of the rotational Raman scattering by polyatomic molecules has been put forward by Placzek and Teller[1]. According to this theory, in the case of the benzene molecule at room temperature, the rotational wing accompanying the Rayleigh line should start with zero intensity at the centre of the Rayleigh line and have a maximum intensity at about 18 wave numbers from the Rayleigh line, and afterwards its intensity, diminishing fairly rapidly, should become zero at about 70 wave numbers from the Rayleigh line. Experimental measurements of the distribution of intensity in the rotational wing accompanying the Rayleigh line scattered by liquid benzene at room temperature have been made by Weiler[2] and more recently by Bhagavantam and Rao[3]. The experimental results do not agree with those predicted by the theory. In order to test whether the results obtained in the case of vapours can be explained by the theory, the distribution of intensity in the rotational wing due to benzene vapour at high temperature and pressure has been measured quantitatively.

A small quantity of distilled benzene was sealed in a thick-walled Jena glass tube of diameter 18 mm., and was heated to 210° C. in a cylindrical electric heater provided with two windows, one along its length and the other at one of its ends. Stray light could not be eliminated completely, but the pure rotational wing on the Stokes side of the Rayleigh line was recorded successfully, because the pressure of the vapour being about 16·6 atmospheres, the intensity of the scattered light was greater than that of the stray light, so that the spreading of the undisplaced line due to stray light was negligible. Also, the particular Fuess glass spectrograph used in the present experiment produced lines which were absolutely free from coma on the Stokes side, though there was an intense coma on the anti-Stokes side.

The microphotometric records of the lines 4046 A. and 4077 A. in the scattered spectrum and of the line 4046 A. in the incident spectrum are reproduced in Fig. 1. The dotted part of the record in Fig. 1 (*a*) would be obtained in absence of the wing. On measuring the relative intensities in different parts of

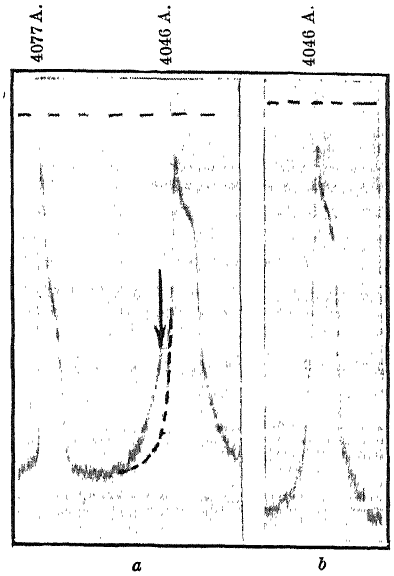


FIG. 1.

the wing, the curve reproduced in Fig. 2 is obtained. The approximate theoretical curve for the benzene molecule at 210° C. is shown by the broken line in Fig. 2. In view of the defects in the experimental arrangements, it can be concluded from the above results that there is fair agreement of the observed facts

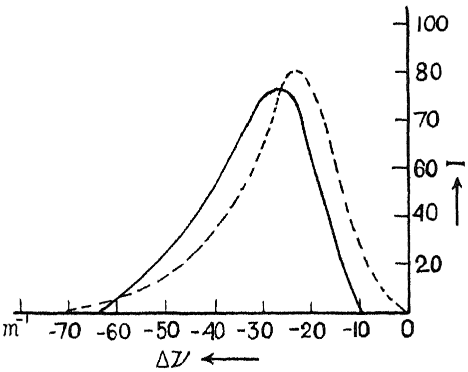


FIG. 2.

with the theory. Probably with a spectrograph having greater dispersion and with a denser picture, the agreement would be much better.

My thanks are due to Prof. D. M. Bose for his kind interest in the work.

S. C. SIRKAR.

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University College of Science,
92, Upper Circular Road, Calcutta.
Sept. 21.

[1] *Z. Phys.*, **81**, 209; 1933.
[2] *Z. Phys.*, **68**, 782; 1931.
[3] *Ind. J. Phys.*, 8, 437; 1934.

Bands at 4450 and 4180 A. in the Spectra of the Night Sky and of the Aurora

IN the observation of the spectrum of the night sky or of the aurora by Vegard, Lord Rayleigh, Slipher, Sommer, Dufay, Ramanathan and others, it has already been reported that bands or lines appear in the regions near 4450 A. and 4180 A. These lines, which have been referred to by Lord Rayleigh as X_1 and X_2, were identified by Kaplan with the OII lines 4416·97 and 4169·23.

In the course of investigations of the band spectrum of nitrogen excited by very weak current under low pressure, I have observed three bands, which have heads at 4728·5, 4432·3 and 4165·9 A., respectively, in addition to other well-known bands. Of the three, the band at 4728·5 A. is the weakest. Under low dispersion, each of these three bands has apparently four intensity maxima (4744, 4740, 4736, 4730; 4448, 4443, 4439, 4434; 4179, 4175, 4172, 4167), and is little degraded towards the longer wavelength side. At ordinary temperature they are emitted only when the nitrogen gas is very pure; and the enhancement of their intensity relative to the second positive bands is observed with increased pressure of nitrogen, and with decreased density of the exciting current. Helium or neon gas exerts no appreciable effect when it was mixed with nitrogen, while the bands are almost quenched by the introduction of argon gas. At low temperature, especially at the temperature of liquid air, their intensity is markedly enhanced.

From the fact that the three bands are almost completely quenched when the temperature of nitrogen is high and when the persistence of vibration is brought out by the introduction of argon, and, therefore, the average vibrational and rotational energies of the normal nitrogen molecules are abnormally high, it is concluded that the upper state of emission is very unstable.

Taking into consideration the wave-length regions where they appear, together with the exciting conditions, it seems that there is a possibility of the identification of the Rayleigh bands X_1 and X_2 in the spectra of the night sky, and perhaps also of the aurora, as the Goldstein bands which I have described above.

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Oct. 9.

Nuclear Spin of Iodine

IN an earlier report[1] on the fine structures in the arc spectra of bromine and iodine, a tentative value of $\frac{9}{2}$ was proposed for the nuclear spin of iodine. The iodine arc spectrum was excited by a high-frequency electrodeless discharge, and as the structures were small and the individual components broad, it was pointed out that the spin value, which was based largely on one line, was not reliable because of imperfect resolution. It was definitely shown then that I was certainly $\geqslant \frac{5}{2}$.

I have now succeeded in exciting both the arc and spark spectra of iodine in a cooled hollow cathode discharge, and the resulting lines are considerably sharper than in the previous source. The fine structures in the spark spectrum, being on a much larger scale, are sufficiently resolved in some lines to enable an unambiguous spin value to be determined. Some fine

structures in the spark spectrum have been previously reported by Wood and Kimura[2], but resolution was incomplete such that, for example, only five components were found in a line shown by the present observations to have ten. For this reason the conclusions about the spin drawn from these early data by Murakawa[3] require further examination.

A partial classification of the gross multiplet terms of the iodine spark spectrum has been given by Murakawa (loc. cit.) but even without this the nuclear spin can be deduced. Thus the lines in the accompanying table exhibit regular degraded quintet patterns, arising obviously from terms with $J=2$. (This agrees with the allocations which are taken from Murakawa.) The calculated interval factors for spins of $\frac{5}{2}$, $\frac{7}{2}$, $\frac{9}{2}$ are given. In a line free from perturbations, these should be constant, and it is quite evident that the nuclear spin of iodine is $\frac{5}{2}$. The slight irregularities in the interval factors calculated for the $\frac{5}{2}$ value are due to the small unresolved upper term fine structures.

Intervals in cm.$^{-1}$ × 10^{-3}

Line	Spin 5/2	7/2	9/2
λ 5496·8	9×47·5	11×39	13×33
	7×47	9×36	11×30
$6\,^5S_2-6\,^5P_1$	5×47·5	7×33	9×26·5
	3×50	5×30	7×21·5
λ 5774·7	9×82	11×67	13×57
	7×78·5	9×61	11×50
$X_2-6\,^5P_1$	5×79	7×58	9×44
	3×76	5×45	7×32
λ 5161·2	9×44	11×36	13×30·5
	7×42·5	9×33	11×27
$6\,^5S_2-6\,^5P_3$	5×42	7×30	9×23
	3×40	5×24	7×17

Structures have been measured in a large number of arc and spark lines and in some of these perturbations have been found. Full details will be published elsewhere.

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Oct. 23.

[1] *Proc. Roy. Soc.*, A, **136**, 585; 1932.
[2] *Astrophys. J.*, **46**, 181; 1917.
[3] *Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, **20**, 285; 1933.

The Burrow of an Enteropneust

STIASNY described how *Balanoglossus clavigerus* lives in a U-shaped burrow, which is characterised by a regular funnel on the surface at the anterior end of the animal, with the coils of fæces at the posterior end. His illustration has been reproduced in several books. Morgan has also found similar funnels and masses of fæces in the case of another species of *Balanoglossus* and it is probable that all species of this genus inhabit similar burrows. Other species of Enteropneusta, for example, those belonging to the genera *Glossobalanus* and *Ptychodera*, live among the roots of seaweeds, under stones or in the sand in irregularly-shaped tubes of sand-grains, etc., cemented together by slime. It is known that most species of *Saccoglossus* (*Dolichoglossus*) prefer to live in a black muddy soil, but Davis is the only author who has described a special burrow for *Saccoglossus pusillus*, and according to his figure this burrow is irregularly formed.

In 1929, Dr. Mortensen collected near Lourenço Marques a new species of enteropneust, the description of which, under the name *Saccoglossus inhacensis*, will shortly be published by one of my students. When I visited the island Inhaca with a number of students in July 1934, we observed numerous specimens of this animal. It lives on the flats at the eastern side of the island, facing Delagoa Bay. In this area there is a surface layer composed of yellow sand, about 1 cm. in thickness, beneath which is a sandy mud, coloured black by its organic contents. *Saccoglossus inhacensis* inhabits burrows of a typical form, which were easily found by lifting a spadeful of mud and breaking it up, several burrows often occurring in one spadeful. The upper part of the burrow is irregularly coiled and within this part the long proboscis, collar and branchial region of the animal are lodged during low tide. Deeper down, about 4–5 cm. under the surface, the burrow takes the form of a regular spiral, consisting of up to six turns, in which the abdominal region of the animal is located. The direction of the main axis of the spiral is variable; in the majority it was found to be approximately vertical, but it may even be horizontal. Nothing of the burrow or tube was seen in

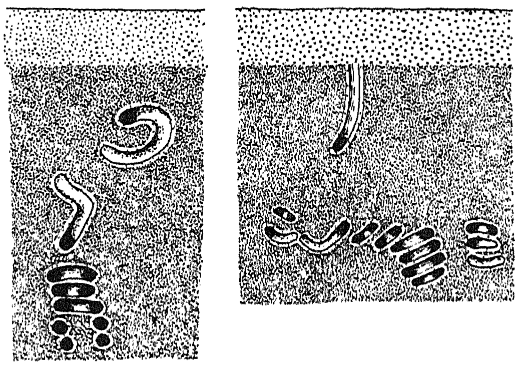

FIG. 1. Burrows of *Saccoglossus inhacensis*. $\frac{1}{2}$ natural size.

the upper layer of clear sand, and no indication of the presence of the animal was found on the surface during low tide. Apparently the animal behaves similarly to *Saccoglossus mereschkowskyi*, which according to Gurjanova and Uschakoff goes deeper down into the mud during low tide. On the other hand, Ritter found that *S. pusillus* protrudes its proboscis above the sand during low tide. It is likely that *S. inhacensis* does not make a permanent tube in the clear sand; it can easily push through this thin layer, when protruding from the burrow during high tide. The burrow itself is undoubtedly of a more permanent nature than is usually the case in Enteropneusta. The spiral part especially is so consistent that it can easily be detached from the surrounding mud.

In the dark mud the burrow is very conspicuous because it is lined by a thin layer of clear sand. This in turn is covered by a layer of slime, giving the inner surface a smooth, shiny appearance. A piece of the mud containing the burrow, such as is illustrated in Fig. 1, was preserved by allowing it to dry up partially, after which small quantities of gum arabic were carefully poured over it.

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Oct. 8.

Whales and Caisson Disease

I DOUBT if whales avoid caisson disease—the usual consequence of deep diving—by filling their lungs with sea-water as Dr. J. Argyll Campbell suggests[1]. Where whales abound, the temperature of the water is sometimes as low as 28° or 29° F. Moreover, their valvular blow-holes seem designed to keep out the sea-water: not to let it in. So far as I have observed, whales expel water from their blow-holes only in the form of vapour.

If Dr. Campbell had said mucous instead of sea-water he might have been, perhaps, on somewhat firmer ground. Scoresby[2] says, "a moist vapour mixed with mucous" is discharged from the blow-holes of the Greenland whale, and as stated in my letter on the "Sleep of Whales"[3], quantities of what looked like mucous discharged from their blow-holes were sometimes seen floating on the surface of the sea.

There is still another way in which the whale might avoid diver's paralysis or caisson disease. I mean by the 'short circuiting' of its pulmonary circulation. This theory also assumes the deeply submerged whale to be independent, as regards oxygen, of the air in its lungs.

The idea of a whale deeply submerged with its lungs short-circuited and living on oxygen stored in its *retia mirabilia*—peculiar vascular organs possessed by whales—is, I understand, not one that appeals to the physiologist; nevertheless, as I have stated elsewhere[4], it is one that seems to explain first, why the *ductus arteriosus* is in a patent condition in whales; secondly, why each time a whale comes up from the depths it remains at or near the surface some minutes during which it takes a number of breaths, and lastly, why the newly-born animal escapes death from drowning.

8 Hartley Road,
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Oct. 27.
ROBERT W. GRAY.

[1] NATURE, **134**, 629, Oct. 20, 1934.
[2] "Arctic Regions," vol. 1, p. 456.
[3] NATURE, **99**, 636, April 30, 1927.
[4] "The Physiology of Whales", *Naturalist*, August 1934.

'Dry Ice' in the Machine Shop

IN the issue of NATURE of October 6, on page 529, mention is made of the use of 'dry ice' in the machine shop.

Some readers of NATURE may be interested to know that dry ice is used regularly by one of our large automobile companies. The exhaust valves on the cars manufactured by the concern in question seat on a ring of heat and corrosion resisting material set into the cast iron of the block. The ring is made over-size by the required amount and is shrunk by means of dry ice. As the motor blocks pass by on a conveyor, the rings are removed from the dry ice refrigerator and are slipped into place in the block. As they come up to room temperature, they of course expand and are held firmly in place.

There would seem to be many advantages in making this type of a fit. Certainly in the case mentioned, the other way of inserting the rings, namely by heating the cylinder blocks, would be expensive and inconvenient.

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Oct. 15.

Freshwater Research in New Zealand

THE New Zealand Freshwater Research Committee commenced in 1932 to investigate the mortality occurring up to the fry stage in the life-histories of wild Brown Trout (*Salmo trutta*), Rainbow Trout (*S. irideus*) and Quinnat Salmon (*Oncorhynchus tschawytscha*).

Observations have been made on thirteen streams, and 180 samples have been taken from spawning redds. More than 80,000 eggs and alevins have been examined.

The average fertility of ova has proved to be 98·9 per cent. In Slovens Creek, 62 Brown Trout fry emerge per 100 eggs lodged in the redds. In Winding Creek there has been a fluctuation in the annual emergence of Quinnat Salmon fry of from 86 to 95 per 100 ova lodged. Losses have been associated with causative factors.

Work is proceeding on further material in hand and will probably be extended to cover most of the important spawning regions in the Dominion.

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Sept. 28.

Sunspot Number and the Refractivity of the Air

IN connexion with the note by L. W. Tilton on the relation between the sunspot number and refractivity of dry air[1], it is of interest to examine whether such a relation may be deduced from the astronomical observations. For this purpose we have selected twenty independent determinations of the refraction constant (μ) and reduced them to 0° C.,

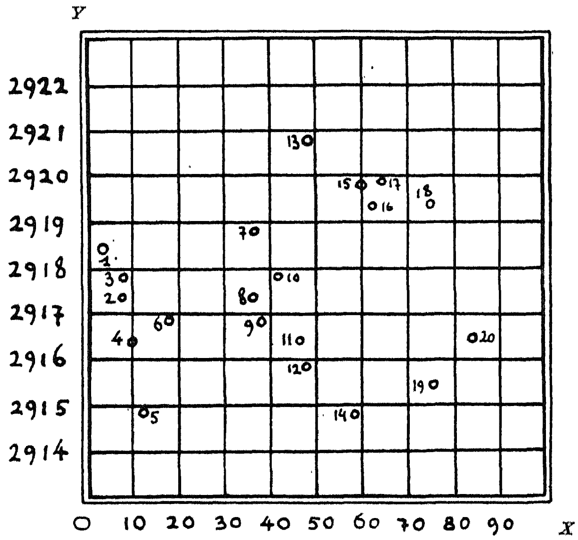

FIG. 1.

760 mm. pressure, 6 mm. vapour pressure (π), $\varphi = 45°$ and sea-level. The corresponding values of the index of air (n) as well as the relative sunspot numbers for the approximate mean epochs of the determinations of μ are shown in the Y and X axes of Fig. 1. The diagram does not show any marked dependence of index of air on sunspot number. Assuming $y = ax + b$, we have: $a = +0{\cdot}10$, $b = 1{\cdot}00029171$, the correlation coefficient being

$r = + 0 \cdot 15$. All the above values of μ are within the limits of $60 \cdot 10''$ and $60 \cdot 22''$. The corresponding values of n are $1 \cdot 0002915$ and $1 \cdot 0002921$, the range of variation being only 6×10^{-7}. The mean of n for $\pi = 0$ mm. is $1 \cdot 00029208$, that given by Tilton being $1 \cdot 00029237$. These values agree well considering that this latter is referred to the D line while in the astronomical observations the bisections of a stellar spectrum are usually made between C and D lines.

Comparing the values of n, as given in Tilton's note and in Landolt-Börnstein's Tables (from 1877 to the present time), with the corresponding sunspot numbers (s) we obtain on the average:

s	n
12	1·0002925
26	26
44	24
64	25
78	24

which, contrary to Tilton's results, does not show any observational evidence of the dependence between n and s.

N. DNEPROVSKY.

Poulkovo Observatory.

[1] NATURE, 132, 855, Dec. 2, 1933.

The Scientific Approach to Peace

WE welcome the leading article in NATURE of November 17, on "The Scientific Approach to Peace", indicating as it does the growing realisation of the special importance of the attitude of scientific workers to war, but we cannot agree with the assertion that the 'realistic' attitude of Prof. Huxley represents the point of view of the majority of scientific workers. In Cambridge alone there are some eighty scientist members of the anti-war movement who adopt a fundamentally different attitude. That we are not alone is shown by Prof. K. T. Compton's article[1] and the talk on the causes of war which was to have been broadcast by Prof. J. B. S. Haldane[2] and which, unfortunately, was not permitted.

At the present time it is clearly out of the question to expect individual scientific workers to cease doing war research, but this could be brought about, as NATURE points out, if they were organised in a powerful professional body. An organisation of scientific workers and other intellectuals in France has already developed in the Comité de Vigilance, which is exerting itself in every direction to prevent another war. Similar activity, which is severely repressed by authority, is being carried on in the United States of America, Germany and Italy. An International Congress of these and similar bodies is being held in Geneva on December 29–31, and it is of the greatest importance that British men of science should co-operate by sending delegates, and by helping financially the delegates from Germany and Italy.

C. B. O. MOHR.
NORA WOOSTER.

(Joint Secretaries of the Cambridge Scientists' Anti-war Group.)

Cavendish Laboratory and
Dept. of Mineralogy and Petrology,
Cambridge. Nov. 17.

[1] *Technology Review*, 36, 295.
[2] *Daily Herald*, Nov. 3, 1934.

Points from the Foregoing Letters

PROF. INGOLD and his co-workers have shown that an exchange of hydrogen atoms can take place between benzene and sulphuric acid, the latter containing heavy hydrogen atoms as indicator. Prof. Polanyi and Dr. J. Horiuti suggest as a general mechanism for hydrogen exchange in unsaturated compounds, the addition and subsequent elimination of water, or other simple hydrogen-containing molecule. Prof. Ingold and his co-workers admit this mechanism in the case of ordinary unsaturated compounds, but with benzene they assume the addition and subsequent elimination of sulphuric acid, the molecules of which are rearranged ('polarised') in the process.

The 'afterglow' of gases following an explosive reaction has been attributed by Prof. David to the presence of excited or metastable molecules like those formed by an electric discharge in a vacuum tube. Prof. David assumes, apart from the usual heat energy, a 'latent energy' of excitation which may amount to 20 per cent of the total. Messrs. Egerton and Ubbelohde agree to the existence of metastable molecules, but believe the energy associated with these to be considerably less.

Prof. Dhar and Mr. Bhargava bring new evidence that light passing through reacting gases is absorbed to a greater extent than by those gases separately. They suggest, further, that the increased absorption of light is a measure of chemical reactivity.

Messrs. Brindley and Spiers show that powdered copper obtained by chemical precipitation scatters X-rays (of wave-length comparable with its absorption edge) more nearly in accordance with theoretical expectations, than do copper filings, the crystalline structure of which is presumably distorted.

Dr. Sirkar describes the Raman spectrum (scattering of light accompanied by change in wave-length) of benzene vapour and points out that it accords with the theory of Placzek and Teller, while the Raman spectrum for liquid benzene does not. The Raman spectrum has already yielded valuable information concerning the structure of organic compounds.

On passing a weak electric current through nitrogen at low pressure, Mr. Hamada has observed three new bands in the violet (4165·9 A.), blue (4432·3 A.) and bluish-green (4728·5 A.) regions. He suggests that the first two might be identified with similar light in the spectra of the night sky, and perhaps also of the aurora.

By means of an electric discharge in a cooled hollow cathode, Dr. Tolansky has obtained more details in the arc and spark spectra of iodine, which enable him to calculate more accurately the nuclear spin of iodine, a constant which plays an important part in determining the probability of atomic transmutation when the nucleus is hit by another particle.

Mr. L. W. Tilton claimed to have found a correlation between the number of sunspots and the index of refraction of air, from analyses of data since 1912. Mr. Dneprovsky, director of the Pulkovo Observatory, taking into consideration values available since 1877, and also data calculated from the astronomical measurements of the 'refraction constant', maintains that no such correlation can be inferred.

Research Items

Cultural Analysis in Western Europe. When Prof. H. J. Fleure touches upon a familiar topic in his occasional lectures, he may be trusted to approach it at a new, or at least unfamiliar, angle. The lectures which he has delivered at the John Rylands Library, Manchester, in the last three years afford apposite examples. The latest, recently published in the Bulletin of the Library, deals with the megalithic problem, and is, in his own words, an attempt to show "that the megaliths are not a matter of a vanished people and a forgotten civilisation; they belong to the core of our heritage as Western Europeans" ("Prehistoric Elements in our Heritage." By Prof. H. J. Fleure. Pp. 36. Manchester: Manchester University Press, and John Rylands Library, 1934. 1*s*. 6*d*. net). He argues with an almost bewildering wealth of detail that the civic civilisation, which developed in early prehistoric times in the Near East, expanded by land and sea to form a series of archæological provinces in distant lands, to which adventurers took something of the religious associations of a common life. In attacking the problem of the megalith, Prof. Fleure has taken the position that buildings, no longer the civic type of orderly shaped stone, but of rough stone, including the megaliths, appear in different regions and at different dates. In other words, it was the concept and not the form which was carried from province to province. These provinces, in which development took place along different lines and with varying stimuli, were none of them isolated; each linked up with others in more than one direction. Among the examples of the persistence of the influence of the megalith and the culture of which it was a manifestation down to Christian times and later, Prof. Fleure cites, *inter alia*, the occurrence of cults from early prehistoric times at places of entry such as that of St. Iago in Galicia and Portugal and that of the saint of St. David's in South Wales.

Brahmins of Behar. A comparative study of the physical characters of two classes of the Brahmins of Behar has been made by Bajra Kumar Chatterjee (Anthropological Bulletins from the Zoological Survey of India, No. 2). Of the six most important groups of Brahmins of Behar, the present study deals with two, the Kanaujia and the Maithil. The Kanaujia hold a very high position among the Brahmins of northern India. Both this group and the Maithil belong to the five divisions known as the *Panch Gaur*. Among the Kanaujia are many exogamous sub-sections having different status for matrimonial purposes, while among the Maithil there are numerous exogamous groups which constitute a complete hypergamous system. A hundred individuals from each of the two groups were measured. Seventeen characters are recorded and thirteen indices calculated, in addition to observations of skin, eyes and hair. A comparison of the two series of measurements shows that the two groups are physically alike in most of the characters, and can with good reason be assigned to the same racial stock. Differences noted in a few characters are probably due to the presence of another strain. A high percentage of certain characters, such as is shown by the breadth-height index and the nasal index, points to miscegenation with some such aboriginal stock as the Bhils or Chenchus. This appears to have proceeded further among the Maithil than in the Kanaujia Brahmins. A further comparison with measurements taken by other observers elsewhere points to the fact that these two groups of Brahmins are related to some of the groups of Bengal, Orissa and southern India. Racial kinship is also discernible with the Namburdiri of Malabar; but there does not appear to be any with the Brahmins of the United Provinces of Agra and Oudh and Central India, this last conclusion being contrary to tradition, which, however, supports the connexion with the Brahmins of Orissa.

Vanadium in Marine Animals and in Mineral Oils. Vanadium has been known to occur in small quantities (of the order of about 10^{-5} per cent) in various terrestrial and marine animals and plants. In two groups of marine animals, namely, Ascidians and Holothurians, it has been found, however, in very high concentrations (up to 1·5 per cent of the ash in some Ascidians). This lends support to the theory according to which Tunicata and Echinodermata are considered of close phylogenetic affinity. Since sea-water contains very small quantities of vanadium, it appears probable that the source of the vanadium found in Ascidians is marine bottom muds, which are often rich in that element. Moreover, Ascidians form highly specialised biocœnoses on the sea-floor, and after their death they should enrich the bottom sediments with vanadium. It is suggested, therefore, by A. Vinogradov (*C.R.*, *Acad. Sci. Leningrad*, **3**, No. 6) that oils containing vanadium are connected in their origin with marine sediments formed under conditions favourable to organisms concentrating vanadium.

Burmese Fishes. A collection of fishes from the South Shan States and the Pegu Yomas, Burma, is described by Dr. Sunder Lal Hora and Dev Dev Mukerji (*Rec. Indian Mus.*, **36**, Part 1, March 1934). The material was obtained by Mr. V. P. Sondhi of the Geological Survey (both of the districts consisting of hilly tracts) from small torrential streams with a rocky bed. The streams are characterised by rapids and slow currents with pools and back-waters here and there. Some of them are diverted for the irrigating of 'paddy' fields, and in the South Shan States the water is usually charged with lime to such an extent that it forms travertine dams causing small falls. The fishes from Pegu Yomas were caught by putting a dam across a small stream and allowing the bed below the dam to run dry, and picking up the fish from underneath stones and boulders and from crevices. An abnormal specimen of *Ophiocephalus gachua*, a widely distributed and very variable species of the Oriental region with a marked amphibious life, had no ventral fins, but had the basipterygials only slightly deformed. This raises the question of the validity of the generic names *Channa* and *Ophiocephalus*, in *Channa* the ventral fins being totally absent. The authors are of the opinion, after examination of a number of specimens, that *Ophiocephalus harcourt-butleri*, Annandale, is synonymous with *O. gachua*.

Trematodes from Deep-Water Fishes. Mr. H. W. Manter has described the digenetic trematodes collected from many species of fishes from 40 to 582

fathoms, trawled at Tortugas, Florida (Papers from the Tortugas Laboratory of the Carnegie Institution of Washington, 28, 1934). The worms are in general markedly distinct from those in the nearby shallow water, and approximate more closely to the cooler water forms of more northerly regions. Seven species are identical with the northern forms, including the common *Derogenes varicus*, which is found in a large number of British fishes, and is very widely distributed. It has been recorded from more than 50 species, 5 more being added in the present work, occurring in depths ranging from 190 to 315 fathoms. Out of 49 trematodes recorded, 15 species belong to the Hemiuridæ, 13 to the Fellodistomidæ and 11 to the Bucephalidæ. Interesting results arising from this research show restrictions in distribution in depth. Thus, some trematodes are able to live in several different fishes, but appear to be limited to certain depths. *Cymbephallus vulgaris* is the commonest species collected, and was found in 15 species of deep-water fishes but never in those from shallow water. It was not found above 40 fathoms, and is most prevalent from 75 to 175 fathoms, not occurring at lower depths. Of the few species occurring both in shallow and deep water, *Sterrhurus floridensis* is very common. This is the only sexually mature form found generally in both shallow water and deep water regions.

Root Rots of the Strawberry. Dr. G. H. Berkeley and Miss Isabel Lauder-Thomson contribute an article on "Root Rots of Strawberry in Britain" to the *Journal of Pomology and Horticultural Science*, 12, No. 3, Oct. 1934. Dr. Berkeley is senior pathologist-in-charge at the Dominion Laboratory of Plant Pathology, St. Catharine's, Ontario, Canada, and lately stayed for a year at the East Malling Research Station, Kent. The 'black lesion' type of strawberry root rot causes severe damage to the crop in Canada, and the present paper shows that it is a serious factor in strawberry degeneration in Great Britain. Five species of soil fungi have been proved capable of attacking the roots of strawberries, often causing death. They are *Coniothyrium Fuckelii, Hainesia lythri, Cylindrocarpon radicicola, Fusarium orthoceras*, and *Pachybasium candidum*. Symptoms do not seem to vary greatly with different fungi, and infected plants are always dwarfed and brown, whilst the roots have black lesions and little fibre. Many dead roots appear, and severely infected plants often wilt and die. Crop rotation and the selection of healthy runners are the main control methods (see also NATURE, 132, 570, Oct. 7, 1933).

Irish Fungi New to the British Isles. Messrs. A. E. Muskett, H. Cairns and E. N. Carrothers are making a study of the fungus flora of Ulster, and publish fresh annotated records from time to time. Their latest contribution reports the addition of 275 species and 9 varieties ("Further Contributions to the Fungus Flora of Ulster", *Proc. Roy. Irish Acad.*, 42, Section B, No. 4, Sept. 1934). No less than 133 species and 8 varieties are new Irish records, whilst two species and one variety are new British records. *Hygrophorus agathosmus*, Fr., var. *aureofloccosus*, Bres. was found by Mr. Carleton Rea at Glenariff in 1931. *Corticium anceps* was found at Hallsborough and was parasitic on bracken, but did not appear to do much damage to its host. *Phytophthora megasperma* was isolated by Cairns from potato tubers affected with pink rot. It has hitherto been described only from the United States, where it causes a disease of hollyhocks. The new fungus can cause a pink rot of potato tubers indistinguishable from that produced by the usual parasite, *P. erythroseptica*. The records include considerable numbers of Phycomycetes and Fungi Imperfecti, in addition to the larger forms.

Turbulence near the Ground. A lecture on this subject was delivered before the Royal Aeronautical Society on November 22, by Prof. W. Schmidt, director of the Austrian Meteorological Service. The lecture was mainly devoted to the discussion of some 350,000 observations of wind in the lowest 10 metres of the atmosphere. The instrument used consisted of a light wire ring of 20 cm. diameter, covered with muslin, and mounted on a horizontal axis 50 cm. from the centre of the ring. In practice, a number of the rings were fixed on a frame set vertically at right angles to the wind direction, the dimensions of the frame being usually 6 m. × 12 m., so that the distribution of wind could be investigated instantaneously over a front of 12 m. across wind and up to a height of 6 m. above the ground, by photographing the frame. Diagrams were shown representing the variation of wind over the area covered by the frame, and the variation of wind with time at different heights above the ground. Over a field of turnips the wind was more turbulent than over a stubble field in the lowest metre above the ground, but was less turbulent at heights greater than 1 metre. Some of the diagrams indicated that the occurrence of high velocities near the ground is to be explained by the intrusion of fast moving air from higher levels. This confirms the results described by Scrase in M.O. Geophysical Memoir No. 52. Tables of coefficients of correlation between the simultaneous observations of wind at points separated by vertical distances up to 5 m. and horizontal distances up to 10 m., showed that the distance at which the coefficient falls off to any particular value increases with height, as might be expected if the dimensions of the eddies increase with height above the ground. The correlations were all smaller with strong than with light winds. This was attributed by Schmidt to the large number of frictional eddies produced in strong winds. The values of the *Austausch* coefficient (eddy diffusivity × density) were shown in a table, the values varying from 0·8 to 5,800 $cm.^{-1}$ $gm.\ sec.^{-1}$, corresponding to a variation of the eddy diffusivity, K, from about 600 to about $4{\cdot}6 \times 10^6$ $cm.^2\ sec.^{-2}$ The very high value was associated with a wind from a lake with 500 metres of dry strand in front of the point of observation.

Crystal-Structure of Bismuth Oxyhalides. At the meeting of the Mineralogical Society of Great Britain on November 1, Mr. F. A. Bannister read a paper giving the results of X-ray study of crystals of BiOCl, BiOBr, and BiOI which he had succeeded in preparing by a diffusion method. They are formed as square plates rarely larger than $0{\cdot}3 \times 0{\cdot}3 \times 0{\cdot}05$ mm. showing flat pyramidal faces vicinal to the basal plane; all yielding a negative uniaxial figure under the microscope. Laue and rotation photographs show that the space-group of these compounds is $P4/nmm = D_{4h}^7$ and that their crystal-structures closely resemble that of matlockite (PbFCl), the main difference lying in the closer packing of the bismuth and oxygen ions than the packing of the lead and

fluorine ions. The unit-cell sides and parameters of the atoms of the bismuth oxyhalides are :

	a	c	u	v
BiOCl	3·89	7·37 A.	0·171	0·650
BiOBr	3·92	8·11	0·153	0·650
BiOI	4·01	9·14	0·132	0·667
PbFCl	4·09	7·21	0·208	0·650

The co-ordinates of the atoms in these structures are :—Metal, $00u$, $\frac{1}{2}\frac{1}{2}\bar{u}$; halogen, $00v$, $\frac{1}{2}\frac{1}{2}\bar{v}$; oxygen, $\frac{1}{2}00$, $0\frac{1}{2}0$. The calculated radius of the bismuth ion for all three oxyhalides is 1·0 A. The interatomic distances within the halogen layers are less than the values usually accepted, especially for the oxyiodide.

Biological Effects of High-Energy Radiation. W. V. Mayneord (*Proc. Roy. Soc.*, A, Oct. 15) considers the possible biological effects of high-frequency radiation of different energies. The radiation gives rise to fast-moving electrons by photoelectric absorption and by recoil (Compton scattering), and with 'hard' radiation the latter is the predominant process. The fast secondary electrons have a range in the tissue corresponding to many cells, but they lose little energy in passing through a single cell, while the slow electrons lose energy much more rapidly. If the biological changes in a cell are effected by the absorption of a small quantity of energy, 'hard' radiation, say, γ-rays, should be very effective relative to X-rays which produce short trails of intense ionisation, while if a large transfer of energy to a single cell is required to affect the latter, the soft rays will be relatively more efficient for equal amounts of absorbed energy. This provides a possible basis for the selective action observed by some workers in which the destruction of rapidly growing cells relative to ordinary cells was more marked with short wave radiation. The paper contains calculations of 'survival curves' of cells exposed to radiation, made on various assumptions about the electronic treatment necessary to kill a cell.

Experiments with Heavy Hydrogen. A. Farkas and L. Farkas have continued their interesting work with heavy hydrogen (*Proc. Roy. Soc.*, A, Oct. 1) and they now suggest that the separation of the hydrogen isotopes by the electrolysis of water is due largely to the simple fact that the equilibrium

$$HD + H_2O \rightleftharpoons HOD + H_2$$

corresponds to a gas phase which is about four times as rich in D as the liquid phase. The composition of the gas obtained by electrolysing various heavy-light water mixtures is similar to that obtained by bringing hydrogen into contact with the mixtures in the presence of a catalyst (palladium black). This reaction explains the fact that the separation factor is not very dependent on the conditions of electrolysis, but it is not the only factor operating since the factor may be higher than six in efficient fractionation experiments. In a second paper, the authors have described the use of the heavy isotope atoms as 'labelled' hydrogen atoms in experiments on the ethylene-hydrogen reaction, performed in presence of a nickel catalyst. The experiments show that an exchange reaction :

$$HD + C_2H_4 \rightleftharpoons C_2H_3D + H_2,$$

takes place as well as the addition reaction :

$$C_2H_4 + HD \rightleftharpoons C_2H_5D.$$

An experiment in which the state of the wire catalyst was followed by testing its efficiency in catalysing the conversion of para-hydrogen was also carried out and showed that at 20° C. and 10 mm. ethylene pressure the wire was nearly completely covered with ethylene.

Effect of Oxygen on Photoelectric Emissivity of Silver. At low temperatures, silver adsorbs oxygen rapidly, and the oxygen is readily removed by evacuation. At high temperatures the adsorption is slower and the oxygen is not removed except by prolonged heating or by treatment with hydrogen. These two types of adsorption have been called 'physical' and 'activated', respectively, and it has been suggested that two types of forces are involved, in physical adsorption forces related to van der Waals' forces, and in activated adsorption those commonly termed electrostatic or valency forces. The theory of electrons in metals recently proposed by Sommerfeld provides a satisfactory picture of electrical forces present at surfaces, and since the photoelectric effect provides a sensitive means of study of the electrical properties of surfaces, A. K. Brewer (*J. Amer. Chem. Soc.*, **56**, 1909 ; 1934) has made an investigation on the adsorption of oxygen on silver on these lines. The photoelectric effect gives a measure of the work function associated with the removal of an electron from the metal surface. Very clean silver was used and the threshold values at 20° and 600° were found to correspond with the wave-lengths 2675 A. and 2725 A., respectively. The following results were found : (1) At room temperature the presence of oxygen slightly enhances the emissivity, the effect disappearing with the removal of the oxygen. (2) After treating in oxygen, the silver was heated in a vacuum and then possessed an abnormally large emissive property, the effect disappearing only after long heating. (3) Heating in oxygen or exposure to ozone destroyed the emissivity. The effects observed under (1) and (2) were associated with 'physical' and 'activated' adsorption, respectively, whilst (3) is associated with the presence of 'surface' silver oxide. The lowering of the work function by 'physical' and 'activated' adsorption is brought about, apparently, by positive oxygen ions, whilst the increase in work function brought about by 'surface' silver oxide is apparently due to negative oxygen ions, since previous workers have shown that negative adsorbed ions raise the electron work function whilst positive ions shift it to lower values.

Enzymic Scission of the Nucleic Acid of Yeast. Following his work on the enzymic degradation of lecithin and lysocithin, Contardi, in conjunction with Ravazzoni, has published (*Rendi. R. Ist. Lombardo*, **67**, Parts 11–15) an account of investigations on the enzymic scission of the nucleic acid of yeast. The results recorded show that the diminution occurring in the rotatory power of aqueous solutions of sodium nucleinate may be due, in some cases, to mutarotation phenomena. The rotation alone is, therefore, insufficient as a means of observing the hydrolysis of the nucleinate. The enzymic action of extracts of rice husk consists first in the almost complete demolition of the sodium nucleinate to simpler organic phosphorus compounds, this action being brought about by the phosphodiesterase at an optimum pH of 4. Afterwards, the whole of the phosphorus is liberated in the form of inorganic compounds as a result of the action of the phosphomono-esterase, this proceeding best when the pH is 5·5.

The Historic Sequence of the Celts

DR. A. B. SCOTT, in his paper on "The Historic Sequence of Peoples, Culture and Characteristics in Scotland, 400 B.C.–A.D. 950", read before Section H (Anthropology) of the British Association meeting at Aberdeen, began by a reference to the two lines of approach into western Europe: (1) up the Danube Valley, (2) along the course of the Save, and thence into the valley of the Po. Between 1200 and 1000 B.C. a division of the Celts, moving westward, was on the Wallachian and Pannonian plains. The Celts moved as colonists, with families, slaves, workers and cattle, escorted by the military caste. The Celts from the Danube stream produced the descendants who first entered Britain as a *P*-preserving folk. The other stream made contact with Greek peoples, Illyrians, Ligyes (Ligurians), Italic peoples. They met non-Celtic neighbours who pronounced Indo-European *Qu* in the throat as well as others who articulated it from the lips as *P*.

Reservoirs of Celtic humanity were formed *en route*, in the Hercynian area, the Isar region, and about the Lakes of Constance and Neuchâtel. These, in turn, spilled out their surplus populations. Long after Gaul had been occupied, groups returned east over the routes of their ancestors such as the Tectosagians, the Tolistoboians (279 B.C.), and certain others who settled in Western Germany. In 600 B.C., the Celts were on the Atlantic sea-board of France. Before 500 B.C. they were on the Atlantic shore of Spain. The descendants of the Danubian stream of Celts were crossing into the British Isles about 800 B.C., and spreading over the land. The tribal names on both sides of the English Channel show that, for a time, the chief Celtic ferry was at the Straits of Dover.

The first, main inflow into Britain, by the Straits about 800 B.C., were Belgæ, Devonians, and Brigantes. The latter included *Manapioi*, the ferrymen of the venture. The Belgæ concentrated round *Venta Belgarum* (Winchester). The *Damnonioi* (Devonians) were pastoral folk. They and the Belgæ penetrated to Ireland and became known there as *Fir Domnann* and *Fir Bolg*. Smaller groups of both, from the English section, spread into Scotland. The *Brigantes* were cultivators, pastoralists and fort-builders. The *Briga* of York was their centre, and they were the most powerful tribe in Britain. All these Celts possessed their own military castes. *Ganganioi*, Brigantes and Manapians were penetrating Ireland between 600 B.C. and 400 B.C.—nearer the former date than the latter.

About 400 B.C., Gaels, according to themselves, arrived in Ireland from the Iberian Peninsula. They secured a footing in parts not occupied by the Iro-British Celts—part of Cork, Kerry and Donegal. They pronounced *Qu* in their throats as *C*. They aimed at control and tribute. Not until their thirteenth generation did they acquire a measure of power. They were a well-armed minority, organised on a military basis; and they exerted themselves to secure control of the high-kingship.

About 350 B.C. a small section of Iro-British Celts issued from Ireland to secure a footing in Scotland. The Gaels called these people *Cruithne*, their designation for all people of Brito-Celtic stock in Ireland. The section that emigrated from the Boyne were warrior-groups, 300 in all; and they were fort-builders. They occupied parts of Man, Rathlin, Islay, Tiree and certain islands in Orkney and Shetland. They were energetic seafarers.

Dr. Scott reviewed the evidence in Pytheas, Julius Cæsar, the "Historia Brittonum", and Ptolemy's "Geographike", pointing to the all-Brittonic outspread "from Totness (Devon) to Burra Head (Shetland)". He then dealt with the transportations of Britons into Scotland by the Romans in A.D. 138 and 182; the consequent alterations in tribal names; and the effect of the counter-migration, more than two hundred years later, under Cunedag, and the creation of the *Cymry*.

According to Dr. Scott, Eumenius evolved the nickname 'Picts', and applied it to the 'unsubmitted' Britons of Stirling and Perth shires who gave Constantius trouble, and endangered his prospects. He observed that 'Picts' became a literary convention among Latin-writing chroniclers for all 'unsubmitted' Britons, and was used by scribes through medieval times into the modern period.

Dr. Scott showed that the military effect of Cunedag's march from the Forth to North Wales was to turn the left flank of the Romans and to accelerate their retreat. The political effect was that *Gwynedd* (North Wales) was recreated. The linguistic effect was that the dialect of Celtic ceased to be *Brythoneg* and became *Cymraeg*. The domestic effect was that the North Britons came among the imperialised Britons as 'co-workers', hence their designation 'Cymry'.

The third contingent of Celtic incomers to Northern Britain was a body of Dalriads from Antrim who called themselves the 'Clan Erc'. They were not Gaels, but were politically allied to them, and tributary to them. They entered Argyll about 500 A.D. They were a small body, well-armed and organised. Their aim was to impose themselves as a ruling caste on the British *Epidioi* of Argyll. At their best, the total strength of the Dalriads was 1,410 houses, and an armed muster of 1,500 men. These are the possessions and military strength on which the Gaelic fabulists base the 'Kings of Alba'; the 'Conquest' of Northern Britain; and other inventions of the medieval Gaelic clergy.

The 'Scots' (Irish) who assisted the Northern Britons against the Romans were the Iro-British allies of the latter from Ulster. Dr. Scott reviewed the political expansion of the Gaels and their ruling caste, and showed how impossible it was, in the then political position, for the Gaels to operate in mid-Britain. He reminded the audience that the Gaels scarcely influenced Scotland until the early Middle Ages through their clergy or the Dalriads: and that after A.D. 736–741 Dalriad power was broken by Angus MacFergus I. For 160 years the MacAlpin ruling caste subjected the central area of Scotland to an administration of destruction. In A.D. 1005, Malcolm II, son of an Iro-British woman of Leinster, broke away from Gaelic methods; and, with the aid of his friend Crinan, began a constructive and unifying policy.

Dr. Scott concluded by pointing out that the first great monastic schools and churches were all founded by men of British or Iro-British blood.

Building Research

THE staff of the Building Research Station now numbers 150, and the results of their work for the past year are embodied in the report* of the Building Research Board for 1933. The work carried out has been very comprehensive, including the investigation of the weathering of building stones, building material of all kinds, the structure and strength of these materials, and the efficiency of buildings from the point of view of the user. The ever-growing volume of special investigations and inquiry work—more than 1,500 inquiries were dealt with during the year—indicates that the activities of the Building Research Station are becoming increasingly known, and that the facilities offered are coming into regular demand.

A considerable amount of work has been carried out on Portland and Clipsham stones, and work on sandstone is in progress. It is found that measurements of 'microporosity' (a measure of the porosity of the oolitic grains—see 1931 report) and 'saturation coefficient' (a measure of the degree of saturation reached under standardised conditions of soaking) form a reasonably certain basis for the expression of an opinion on the quality of any particular sample of Portland stone of the normal type. Tests on the Clipsham stone have led to the conclusion that the more shelly type is of superior weathering quality. The crushing strength of stones is found to be a quality quite independent of their resistance to weathering.

* Department of Scientific and Industrial Research: Report of the Building Research Board, with the Report of the Director of Building Research for the year 1933. Pp. x+139. (London: H.M. Stationery Office, 1934.) 2s. 6d. net.

Work on stone preservatives shows that the effective life of certain of the materials commonly employed is limited to about 12–18 months.

Many investigations on bricks are described. Research was carried out to discover the amount of soluble salts a brick may safely be allowed to contain. It is stated that a brick containing 0·1 per cent of water-soluble magnesium sulphate would almost certainly cause failure in plaster applied to it; but an equal amount of calcium sulphate would be quite innocuous.

The behaviour of bricks depends greatly on their texture. Examinations of bricks from different regions of a kiln showed serious underfiring in some of these regions. A systematic firing of different clays under different conditions of temperature and kiln atmosphere is now progressing. The behaviour of the various bricks was examined by exposing them in a 'cemetery', the bricks being partly buried in soil. The results effectively dispose of the idea that high crushing strength denotes great resistance to exposure.

Many other investigations are described dealing with the thermal expansion of glass, paints, cement and concrete, the effect of sea-water on concrete, the effect of moisture content on the thermal resistance of fibre board, asphalt roofing, the supposed effects of different types of heat radiation on health, etc., all of which are of great scientific interest and practical importance. The volume is one of the most striking examples of the applications of the methods of scientific investigation to problems of everyday life which has recently appeared, and it appeals to a wide range of interests.

Angle of Incidence of Short Waves in Radio Reception

IN radio reception, a knowledge of the angle of incidence at the ground of short waves returned from the ionosphere is important. The accurate design of antenna arrays for radio communication by the beam system requires information as to the angle of elevation at which the beam is to be projected and of the corresponding angle of arrival.

A paper by Mr. A. F. Wilkins (*J. Inst. Elec. Eng.*, June) describes some experimental measurements, carried out at the Radio Research Station, Slough, of the angle of incidence at the ground of short waves from some American radio-telephone transmitting stations. The angles of incidence were determined from the phase differences of the E.M.F.'s which the arriving waves induced in two similar horizontal aerials at the same height above the ground. To achieve this, the aerials were connected by transmission lines to two similar receivers the outputs from which gave a trace on the fluorescent screen of a cathode ray oscillograph. If the two aerial E.M.F.'s were in phase, a straight line at 45° to the oscillograph axes would be produced on the screen. When the E.M.F.'s are equal in amplitude but are not in phase, the trace on the oscillograph screen will be an ellipse with its major axis lying along the 45° line. The phase difference is then the angle subtended by the minor axis at the end of the major axis of this ellipse.

The aerial system at Slough was set up particularly for observations on the signals from several stations at Lawrenceville, New York, on wave-lengths of about 20 metres. The results obtained show that, over the period January–April 1933, one main ray accompanied by other rays of smaller amplitude was received during the normal working period of these stations. The average angle of incidence of this main ray was 72° measured from the normal to the ground. During the above period this angle remained fairly constant and the oscillograph traces were similar from day to day. Towards the end of April, however, a marked change in the diurnal variation both of angle of incidence and of signal intensity became apparent. At the commencement of transmission, about noon G.M.T., the angle of incidence was about the value given above; but this angle was found to increase gradually until values of 80°–90° were obtained towards sunset. A decrease in the average signal intensity was also noticed during the same period.

These changes are explained as being due to the increased absorption during the summer months, consequent on the greater density of ionisation in the *E* region of the ionosphere, through which the waves have to travel before and after their reflection at the *F* region. The rise in angle of incidence exhibited during the evening at Slough is a result of the diminution of the absorption in the *E* region as the ions start to recombine. This investigation is being continued on a systematic basis with the aid of special pulse transmission from the American stations.

Training Chemists for Administration

IN a series of articles published in recent issues of the *Industrial Chemist*, there will be found many pertinent observations and useful suggestions regarding the problems connected with the training of chemists for administrative posts in industry. In an editorial, it is pointed out that chemists have all too often been regarded as unfitted for high administrative positions, a disability which they have been alleged to share with other scientific workers. Few technical men are to be found on boards of directors and in managerial positions. Incidentally, this peculiarity is one of the many distinctions between British and German technical industry.

In the August number, Mr. R. Brightman, in an article on "Some Problems of Industrial Recruitment and Leadership", remarks that industry does not appear to have considered seriously as yet whether training for management might not well be given at an intermediate stage in an industrial career, when those undergoing the training have some store of industrial experience on which to draw. If such training were limited to those who have afforded indications both of the capacity and the ambition for high administrative posts, such as is required from naval and military officers before undergoing advanced theoretical training in naval war schools or staff colleges, industry may possibly find in it one solution of the problem of securing a supply of administrators of the requisite quality.

Mr. Brightman argues that much closer co-operation is required between industry and education as well as more intimate knowledge of each other's requirements. Our existing educational facilities when fully utilised should be adequate for industrial requirements subject to (1) the reorganisation of elementary education on the lines recommended by the Hadow Committee, and (2) the gradual transfer of technical education from evening classes to part-time day instruction.

In the September issue of the *Industrial Chemist*, Mr. H. Lewis writes on training for administration in the chemical industry. Previously, he points out, it was possible to obtain most of the knowledge required by working through the departments of a firm, and this is the method adopted by small firms at the present, and often by the large firms through a trainee system. There are, however, many serious obstacles in the way of obtaining an adequate understanding of the varied problems of management of a large organisation by this method, and at best, it often becomes merely an instructional course in the methods of production. It is rarely that breadth of outlook can be obtained from experience in an individual firm, and resort must therefore be made to some other method of obtaining this necessary adjunct for effective management. Facilities for the study of administrative subjects are now becoming increasingly available in various centres, but so far it would appear that the only systematically organised institutional course in England dealing specifically with administration in chemical works is that provided by the Manchester College of Technology in the Department of Industrial Administration ; the subjects comprised in this course being economics, organisation of industry and commerce, industrial history, chemical economics and markets and chemical works organisation.

In the October number, Mr. H. Housley suggests that the chemical industry can usefully employ several groups of chemists ; there will be a large group who have decided to make chemical work their vocation, but others might combine the training and experience of the chemist with that of accountancy or engineering or administration. He argues that industry requires a number of schools situated in the more important industrial centres, each offering an organised course in administration covering a period of two or possibly three sessions.

Studies in Perseveration

AT an inter-sectional discussion on perseveration in Section J (Psychology) of the British Association meeting at Aberdeen, Dr. Wynn Jones, who opened the discussion, indicated that manifestations of perseveration may be classified in various ways, for example, as affective, conative, ideational, sensory or motor aspects of mentality. The study of the interrelation between these forms of perseveration has not received adequate attention. He further pointed out that investigators agree in finding evidence for a common factor in the motor tests. It was also suggested on the basis of a preliminary investigation with siblings as subjects that it may be possible to determine whether any of the alleged manifestations of perseveration are subject to hereditary influences.

Dr. W. Stephenson discussed the terms clearness variation, secondary function, perseverative tendency, general inertia, perseverations and stereotypies. In a series of propositions it was suggested that (1) there is a *p*-factor, but its explanation might lie in clearness variation and its laws ; (2) the *p*-factor makes contact with estimates of character, but the explanation of the contact is open to doubt—it cannot be accepted, for example, that general inertia is a fundamental principle subserving the formation of character and conduct generally ; (3) suggestions for the required fundamental principle would seem to come from (*a*) the observed facts of compulsion-repetitions, (*b*) the underlying principle being either that described by Freud as "beyond the pleasure-pain principle" (the "death instinct"), (*c*) or a psychical process impelling activities towards reinstatement of an earlier condition, now, however, a purely unconscious process.

Dr. P. E. Vernon criticised perseveration tests on the grounds that they have in the past been chiefly of a sensory or motor type. Temperament and character may be regarded as organised hierarchically, and in order to measure the 'higher levels' (that is, the more fundamental and significant traits), it is essential to use higher level approaches, that is, test situations which seem meaningful and important to the subject who is tested. Most sensori-motor tests tend to appear trivial or artificial to the subject, and in spite of their objectivity and statistical

reliability, they have usually failed to correlate to any considerable degree either with intellectual capacities or with orectic traits.

Experimental evidence was brought forward by the Rev. J. Leycester King to show that strong perseverators have a narrow mental complex-span, that is, they are unable to group more than a few single mental elements and grasp them as a new complex whole. In the course of the discussion, Dr. King expressed the opinion that the resonance theory of Lindworsky points the way to a simple formulation under which all the various phenomena ascribed to perseveration can be accounted for satisfactorily.

University and Educational Intelligence

CAMBRIDGE.—Miss S. M. Manton, of Girton College, has been approved for the title of the degree of Sc.D.

It is proposed that Mr. J. T. Saunders, of Christ's College, should be appointed secretary general of the faculties in succession to Mr. R. E. Priestley, of Clare College.

Dr. A. N. Drury, of Gonville and Caius College, Huddersfield lecturer in pathology, has been elected to a supernumerary fellowship at Trinity Hall.

EDINBURGH.—The jubilee of the Students' Representative Council, which was founded in 1884, was celebrated on November 20 at a luncheon held in the debating hall of the University Union. The Lord Provost, who proposed the toast of the University, congratulated the Council and wished it continued success and prosperity. Sir Thomas Holland spoke of compensating the senior president of the Students' Representative Council by giving him the opportunity of attending the University free of fees after his year of office for one year in addition to the normal number for his degree, so that he might obtain the class in his degree which indicated his high quality, and stated that a similar offer was to be made to the presidents of the University Union and of the University Womens' Union. Prof. G. L. Gulland, who was one of the executive of the first Students' Representative Council, afterwards addressed a large number of students on student-life fifty years ago.

LONDON.—The title of reader in industrial physiology in the University has been conferred on Mr. G. P. Crowden, in respect of the post held by him at the London School of Hygiene and Tropical Medicine.

The Petrie Medal for distinguished work in archæology has been awarded to the Abbé Henri Breuil, professor of prehistoric ethnography at the Institute of Human Palæontology and of prehistory at the Collège de France.

OXFORD.—The preamble of a statute establishing a permanent readership in soil science has passed Congregation. If the statute itself is approved, a decree will be proposed constituting Mr. C. G. T. Morison, student of Christ Church, the first holder of the office of reader under the statute. It is mainly to Mr. Morison that the present important position of the study in Oxford is due.

Congregation has also approved the preamble of a statute instituting Honour Moderations in Natural Science. This new examination is not intended to interfere with the Final Honour School in Science; its object is rather to provide an opportunity for those who may wish to acquire a wide but sound education in physical and biological sciences as part of a general education.

THE next election to Beit fellowships for scientific research will take place on or about July 12, 1935. The annual value of a fellowship is £240, and it is tenable for two years at the Imperial College of Science and Technology. Applications must be received on or before April 11. Further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

THE following scholarships, tenable for three or four years, are offered by the Institution of Naval Architects for competition in 1935: Martell (£130 per annum) and Trewent (£125 per annum) scholarships in naval architecture; Yarrow (£100 per annum) scholarship in marine engineering. For these scholarships, candidates must be less than twenty-three years of age. The Denny scholarship (£75 per annum) is offered for competition by boys entering the University of Glasgow for a course in marine engineering. Further information can be obtained from the Secretary, Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

THE annual conference of the Geographical Association will be held at the London School of Economics on January 2–5, 1935, under the presidency of Lord Meston. On January 2, Lord Meston will deliver his presidential address entitled "The Geography of an Indian Village". Among the lectures to be delivered are: Brig. H. St. J. L. Winterbotham, "Ordnance Survey History"; Dr. L. Dudley Stamp, "Planning the Land for the Future: a Comparison of Land Utilisation Studies in the United States and Britain"; Dr. Allen Mawer, "The Geographical Value of a Study of Place Names"; Dr. G. P. Gooch, "Geography and International Problems"; Dr. Bernard Smith, "Water Supply". On January 2, a symposium on Russia will be held in conjunction with the Le Play Society; and on January 4, some new geographical films will be exhibited. Further information can be obtained from the Clerk, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester, 1.

FROM the Universities Bureau of the British Empire we have received a copy of its report for the year ending July 31, 1934, the last of the five years during which the post of honorary director was held by Sir H. Frank Heath, who has now retired. The Executive Council has passed a resolution of regret at the death of Sir Donald MacAlister, whose association with the Bureau dated back to its inception in 1912, and contributed powerfully towards keeping alive the spirit of inter-university co-operation evoked at the congress held in that year. That the capacity for spontaneous co-operation is widespread among the university governing bodies is demonstrated by the fact that the list of members of the Bureau includes all those of Great Britain and Ireland, and nearly all the larger universities of other parts of the Empire, the most conspicuous exceptions being the Universities of Bombay, Manitoba and British Columbia. The Bureau's admirable "Yearbook", published annually, is well

known throughout the learned world. During the year, there was a marked increase in the number of inquiries received from foreign countries, mainly owing to the fact that the Foreign Office has intimated to its representatives that the Bureau is prepared to supply information regarding general university matters.

Science News a Century Ago

Meteorological Tables

In a report rendered by the Secretary of the Royal Society on December 1, 1834, it was stated that "by an arrangement made with the editor of the weekly journal, *The Athenæum*, the expense of printing the Meteorological Tables, formerly appended to the *Philosophical Transactions*, will be saved; the editor, in consideration of their being given to that journal exclusively, having agreed to deliver 1000 copies of those tables, printed in manner and form to correspond with the *Transactions* every six months, to be bound up with the latter, free of all cost to the Society". (*Roy. Soc. Abstracts*, vol. 3.)

Entomological Society of London

At a meeting held on December 1, 1834, J. O. Westwood read a memoir entitled "Observations upon the Organization of the Mouth of the *Anthophora retusa*, and upon the nature of the parasitic connexion existing between the working and parasite Bees". Westwood exhibited numerous figures, illustrative of parts of the mouth in different degrees of protrusion. A discussion ensued between Mr. Shuckard and Westwood, the former alleging that the statements therein contained were "destitute of novelty"; whilst the latter affirmed that neither in the works of Latreille, Kirby, Réaumur, nor in any other writer that he had consulted had the curious apparatus described by him for throwing out the labium to its fullest extent from within the extremity of the tubular mentum been noticed. The Rev. F. W. Hope exhibited an extensive series of silk-moths from his own and the collection of Mr. J. G. Children; also, a branch of a tree covered with the cocoons of an exotic silk-moth from the collection of the Naval and Military Museum. (*J. Entom. Soc.*, 1834.)

J. D. Forbes and Quetelet

On December 5, 1834, J. D. Forbes, writing from Edinburgh to Quetelet, said: "I have recently been experimenting with Melloni's Thermo-multiplier, and have been much delighted with it. Very lately I have been enabled to establish beyond a doubt the polarization of non-luminous heat; and have verified Melloni's experiment of the refraction of the heat of boiling water."

"To-day I commenced a register with a particular view to you. I have got an apparatus for weighing and measuring men, and shall collect annually as many results from the students of my class as possible, and also their strength by Regnier's Dynamometer. I distinguish their age and native country. . . . Amongst my many other pursuits, as I mean to begin on optics this winter, I have been studying the undulatory theory with great admiration. We are, I am sure, much indebted to you for putting Herschel's Treatise on Light into a more convenient form than we can find it in England."

Societies and Academies

EDINBURGH

Royal Society, November 5. L. M. DAVIES: The geology of Inchkeith. This island was last surveyed geologically by Sir Archibald Geikie in 1860. Col. Davies replaces Geikie's map by more modern ones; distinguishes between intrusive and extrusive igneous rocks, giving particulars as to their natures; and describes the sedimentary sequence throughout. The drift geology of the island is also systematically described for the first time; and a list is given of the fossils found on Inchkeith. Appendixes are added, on the drift deposits by Dr. R. Campbell, and on the entomostraca by Miss M. H. Latham. C. F. DAVIDSON: The Tertiary geology of the Island of Raasay, Inner Hebrides. The Tertiary igneous rocks of Raasay and South Rona include olivine-basalt lavas, an intrusive suite of acid and basic sills, and a large number of dykes. The major sills are riebeckite-bearing granophyres, and highly differentiated olivine-dolerite (crinanite) types with abundant segregations, including picrite, teschenite, syenite and numerous pegmatites. The petrogenesis of these is discussed. Comparable rocks are found in the dyke-suites, where differentiates also include analcite-basanite and analcite-tephrite. One olivine-dolerite dyke fuses granophyre xenoliths into pitchstone. Other analysed intrusions include a leidleite pitchstone dyke, a peridotite dyke and an elongated boss of gabbroidal teschenite, while a series of vents are believed to represent hot springs of Tertiary age. The paper concludes with notes on the recent earth-movements of these islands. B. P. WIESNER and N. M. SHEARD: The duration of life in an albino rat population. H. W. TURNBULL: The invariant theory of the correlation. This is an extension of methods already utilised in dealing with bilinear and quadratic forms to a class of transformations which occur in algebraic geometry, called correlations. The main results prove to be simpler than might be expected.

PARIS

Academy of Sciences, October 29 (*C.R.*, 199, 813–896). LOUIS DE BROGLIE and JACQUES WINTER: The spin of the photon. HENRI EYRAUD: The most precise value of a distribution. GEORGES BOULIGAND: The general properties concerning the distribution of the limits at a singular point of a compact field. HERMANN MÜNTZ: Mixed problems in heterogeneous space. The equation of heat in *n* dimensions. ALBERT TOUSSAINT: Contribution to the study of the interactions when 'taxi-ing' for sustaining wings in tandem. Application to the case of a principal wing associated with a very small front auxiliary wing. HÉGLY: The propagation of a solitary wave in a reduced canal with trapezoidal section. EDMOND BRUN: The friction couple to which a disc turning in air is submitted. Results of an experimental study. MAX SERRUYS: Detonation and pseudo-detonation in internal combustion motors. MARCUS BRUTZKUS: A method for the study of the process of combustion in motors. J. ELLSWORTH: The photometric study and new elements of the double system with eclipses of U Cephei. J. E. VERSCHAFFELT: The application of the principles of thermodynamics to conductors. ALFRED LIÉNARD: The Peltier and Thomson phenomena and entropy. ARKADIUS PIEKARA and MAURICE SCHÉRER: The influence of the magnetic field on the dielectric constant of liquids. Measurable increases of the dielectric constants of

eight liquids have been found with a magnetic field of 51,000 gauss. The effect falls off rapidly as the field strength decreases, and becomes insensible when the field is less than 25,000 gauss. CHARLES HAENNY and GASTON DUPOUY: The paramagnetic properties of cerous salts in solution. The mean value found experimentally for the magnetic moment of cerous ions in solution in the case of strong electrolytes is 2·49 Bohr magnetons, very near the value of the theoretical moment calculated by Van Vleck, 2·56. NICOLAS STOYKO: The influences of magnetic disturbances on the velocity of propagation of long electromagnetic waves. Study of the results of 14,000 observations of long wave reception. For each year, the time of propagation diminishes with increase of the magnetic disturbance, or in other words, the apparent velocity increases. This effect is attributed to variations in the height of the ionised layer of the upper atmosphere produced by the magnetic perturbations. W. ARKADIEW: The diffraction of electric waves chemically recorded. The method is based on the application of a detector of the Branly type furnished with electrodes of various metals: the paper is impregnated with a solution giving a change of colour on passage of the current. Two diagrams showing the results obtained are given. VICTOR HENRI: The carbonyl group of aldehydes and ketones compared with carbon monoxide. Conclusions drawn from the study of ultra-violet spectra. There is no correspondence between the vibration frequency of carbon monoxide and that of the carbonyl group in molecules: the Raman, infra-red and ultra-violet spectra all agree in showing this difference. This is interpreted in terms of differences in electronic states. GEORGES BRUHAT and PIERRE GRIVET: The photoelectric analysis of elliptical vibrations. GUY EMSCHWILLER: The chemical action of light on the diiodo derivatives of hydrocarbons: diiodoethanes, diiodomethane. HORIA HULUBEI and MLLE. YVETTE CAUCHOIS: A new technique in the crystalline spectrography of the γ-rays. G. MONOD-HERZEN: A periodic property of the atomic nuclei. PIERRE CHEVENARD: The relation between the heterogeneity of a solid solution and its mechanical and chemical properties. RENÉ PÂRIS: The thermometric study of the precipitation of insoluble ferrocyanides. In the case of simple precipitations with potassium ferrocyanide, the thermometric method leads to the same results as other methods of indirect chemical or physico-chemical analysis, but more rapidly. ARAKEL TCHAKIRIAN: The action of potash or soda on germanoformic acid. LOUIS MARMIER: A catalyst for the production of nitric acid by the oxidation of ammonia. The catalyst used was pozzolana covered with a thin layer of a metal or metallic oxide. Of the metals studied, platinum and chromium proved the most efficient. With chromium, 33–45 per cent of the theoretical quantity of nitric acid was obtained, and it is concluded that chromium might with advantage replace platinum in certain cases. MME. YVONNE KHOUVINE: The alkaline isomerisation of β-glucoheptose. ERNEST FOURNEAU and J. DRUEY: The preparation of 4-iodopyrocatechol. A. SAKAÉ MIHARA: The succession of Permian eruptions in the Vosges (Niedeck). JACQUES FROMAGET: The geological structure of the crystalline and metamorphic base of the River Noire and of Haut Song Ma to the north of the parallel of Dien Bien Phu (Western Tonkin). FRANÇOIS QUIÉVREUX: A fossil-bearing level of the Oligocene potash basin. PIERRE LEJAY: The determination of the quantity of ozone contained in the atmosphere in the neighbourhood of Shanghai. JEAN BEAUVERIE: The causes of the individual resistance of cells of micro-organisms of the same species submitted to the action of the ultra-violet rays. There is a direct relation between the resistance of beer yeast to the action of ultra-violet light and the amount of glycogen in the cells. The glycogen has a protective action against the rays. JOSEPH SIVADJIAN: The pharmacological study of a conditioned reflex. J. ANDRÉ THOMAS: The physiological aspect of the spontaneous transformation *in vitro* of fibrocytes into macrophages. ETIENNE RABAUD and MLLE. MARIE-LOUISE VERRIER: The swim-bladder and the volume variations of fishes. MAURICIO GOMEZ and ANDRÉ LANGEVIN: The utilisation of piezoelectric quartz for the study of certain biological phenomena and especially for the study of the variations of blood pressure in the vessels. Study of the causes of error in earlier applications of the piezoelectric quartz, and description of measures taken to avoid such errors. Two piezograms are reproduced. LOUIS LUTZ: The soluble ferments secreted by the Hymenomycete fungi. The cytolysis of cellulose. RAOUL LECOQ: The food value of mannite and sorbite in relation with the equilibrium of the ration.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 4). R. KUZMIN: Theory of the deformation of surfaces. D. PANOV: Some cases of exact solution of problems relating to the bending of a prismatic beam of symmetrical section. G. KRUTKOV: Linear problems of the theory of Brownian movement (2). N. KURCHATOV, L. MYSOVSKIJ, G. SHCHEPKIN and A. WIEBE: The Fermi effect in phosphorus. B. KURCHATOV, I. KURCHATOV, G. SHCHEPKIN and A. WIEBE: The Fermi effect in alluminium. L. MYSOVSKIJ, I. KURCHATOV, N. DOBROTIN and I. GUREVITCH: Possibility of disintegrating nuclei by neutrons with the emission of three heavy particles. V. KRAVCOV: Heights of the potential barriers in the atomic nucleus. N. KREMENEVSKIJ: The molecular absorption of mercury vapour in the Schumann region. N. DOBROTIN: The method of determining the statistical angular distribution of particles inside a Wilson chamber. S. FRISCH and V. TCHERNIAJEV: Methods of enriching hydrogen in its heavy isotope. M. ELJASHEVITCH: An analysis of the pure rotation spectrum of the water molecule. N. PRILEZHAJEVA: Decomposition of $Pb(C_2H_5)_4$ in the glow discharge. N. ZELINSKIJ and N. SHUIKIN: An unexpected and peculiar transformation of cyclohexane under the influence of a nickel catalyst. V. SADIKOV and A. SHOSHIN: Alteration of protein properties during meat storage in antiseptic conditions. M. KRAUSE, M. NEMTSOV and E. SOSKINA: An investigation of the polymerisation of olefines. Kinetics of the thermal polymerisation of propylene, isobutylene and amylene. I. KITAIGORODSKIJ and L. LANDE: The preparation of iron-free glass. E. SOTNIKOV: Production of citric acid by *Aspergillus niger*. (1) Production of citric acid in unchanged solutions. (2) Production of citric acid in changed solutions. S. KRAEVOJ: The tri-, tetra- and hexaploid chromosome complements in somatic cells of *Scorzonera tau-saghiz*. J. KERKIS: Mechanism of the development of triploid intersexuality in *Drosophila melanogaster*. P. and A. LEBEDEV: The geochemistry of titanium and vanadium in western Siberia. S. NEMOVA: Results of a petrographic investigation of the sedimentary strata in Sakhalin Island.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, December 2

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. K. G. Blair: "Sexual Dimorphism in Insects".*

Monday, December 3

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. Malcolm Smith: "Poisonous Snakes and their Venom".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Dr. L. W. Hackett: "Malaria in Europe" (Heath Clark Lectures. Succeeding lectures on December 4, 5, 6 and 7).*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Mr. Hugh Ruttledge's film of the Mount Everest Expedition, 1933, and other Mount Everest films.

Tuesday, December 4

ROYAL SOCIETY OF ARTS, at 4.30.—E. W. Bovill: "Empire Production of Essential Oils for Perfumery".

Wednesday, December 5

UNIVERSITY COLLEGE, LONDON, at 5.—Miss Violet Mason: "Folklore of the Cotswolds".*

Friday, December 7

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS, at 10 a.m.—(at University College, Gower Street, W.C.1).—A symposium on "Technical Aspects of Emulsions".*

SOCIETY OF CHEMICAL INDUSTRY (LIVERPOOL SECTION), at 6—(at the University).—Dr. J. T. Conroy: "The Alkali and Associated Industries—a Retrospect" (Hurter Memorial Lecture).*

BEDSON CLUB (ARMSTRONG COLLEGE, NEWCASTLE UPON TYNE), at 6.30.—Dr. W. H. Mills: "Some Stereochemical Questions" (Bedson Lecture).

INSTITUTE OF CHEMISTRY (LONDON AND SOUTH EASTERN COUNTIES SECTION).—Streatfield Memorial Lecture.

ROYAL INSTITUTION, at 9.—Dr. C. H. Desch: "The Crystallisation of Alloys".

BRITISH INSTITUTE OF RADIOLOGY, December 5–7. Annual Congress and exhibition of X-ray apparatus to be held at the Central Hall, Westminster, S.W.1. To be opened by Sir Humphry Rolleston.

December 6.—Dr. H. H. Berg: "The Digestive Mucosa" (Silvanus Thompson Memorial Lecture).

December 7.—Sir William Bragg: "X-Rays and the Coarse Structure of Materials" (Mackenzie Davidson Memorial Lecture).

Official Publications Received

GREAT BRITAIN AND IRELAND

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July 1933. Pp. 93. (Shinfield: National Institute for Research in Dairying.)

Survey of Thunderstorms in the British Islands. Summer Thunderstorms: Third Annual Report, 1933. By S. Morris Bower and others. Pp. 36+vi+6 plates. (Huddersfield: Thunderstorm Census Organisation.) 2*s*. 6*d*.

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1933. Pp. 20. (Birmingham.)

Ministry of Labour. Reports of Investigations into the Industrial Conditions in certain Depressed Areas of 1, West Cumberland and Haltwhistle; 2, Durham and Tyneside; 3, South Wales and Monmouthshire; 4, Scotland. (Cmd. 4728.) Pp. 240. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

"This Surprising Lancashire!" Some Views and Notes published at the direction of the Municipal Finance Committee on behalf of the Lancashire Industrial Development Council. Pp. 48. (Manchester: Lancashire Industrial Development Council; London: W. H. Smith and Son, Ltd.) 6*d*.

Rubber and Agriculture. Pp. 64. (London: Rubber Growers' Association.) Free.

OTHER COUNTRIES

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 111: A Simple Method of Calculating the Induced Velocity of a Monoplane Wing. By Itirô Tani. Pp. 65–76. 15 sen. No. 112: Motion of Stretched String in a Turbulent Flow of Air. By Daizo Nukiyama. Pp. 77–100. 20 sen. (Tôkyô: Koseikai Publishing Office.)

Science Reports of the Tokyo Bunrika Daigaku, Section B. No. 25: Brachyura from the Coast of Kyusyu, Japan. By Tune Sakai. Pp. 281–330+plates 17–18. 80 sen. No. 26: Bryozoa Fauna in the Vicinity of the Shimoda Marine Biological Station. By Yaichirô Okada. Pp. 20+2 plates. 30 sen. No. 27: The Aquatic Insects at Nikkô. By Yaichirô Okada and Isamu Horasawa. Pp. 21–27. 15 sen. (Tokyo: Maruzen Co., Ltd.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 33, Part 5: Spiders from Hokkaido. By Saiburo Saito. Pp. 267–362+plates 12–15. (Tokyo: Maruzen Co., Ltd.)

Travaux du Laboratoire de Microbiologie de la Faculté de Pharmacie de Nancy. 1934, Fascicule 7. Pp. 234. (Nancy: Faculté de Pharmacie.)

Forest Bulletin No. 85: A Record of the Results obtained with Experimental Treated Sleepers laid in the Indian Railways between 1911 and 1916. By S. Kamesam. Pp. iii+35. (Delhi: Manager of Publications.) 8 annas; 10*d*.

Report of the Botanical Survey of India for 1932-33. Pp. 12. (Calcutta: Royal Botanic Gardens.)

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 3, Part 1: The Three Main Styles of Temple Architecture recognised by the Śilpa-Śāstras. By Dr. F. H. Gravely and T. N. Ramachandran. Pp. 26+2 plates. (Madras: Government Press.) 1 rupee.

Memoirs of the Geological Survey of India. Vol. 63, Part 2: The Iron-Ore Deposits of Bihar and Orissa. By H. Cecil Jones. Pp. iv+167–302+xxv+plates 13–32. (Calcutta: Geological Survey of India.) 7.10 rupees; 13*s*.

Journal of the Indian Institute of Science. Vol. 17A, Part 7: Preparation of Sugar Syrup from Cashew Apple (*Anacardium occidentale*, Linn.). By M. Srinivasan. Pp. 85–94. 14 annas. Vol. 17B, Part 2: Studies in Dielectrics, Part 1: The Effect of Superimposed Magnetic Fields on the Breakdown Voltage of Dielectrics; Part 2: The Effect of Superimposed Magnetic Fields on the Permittivity and Power Factor of Dielectrics. By N. V. Narayanaswami and F. N. Mowdawalla. Pp. 19–46. 2.4 rupees. Vol. 17B, Part 3: Radio Field Intensity Measurements at Bangalore during the Polar Year. By P. L. Narayanan. Pp. 47–67. 1.8 rupees. Vol. 17B, Part 4: Studies in Dielectrics, Part 3: The Effect of Successive Discharges on the Dielectric Strength of Liquids; Part 4: The Effect of Impurities on the Breakdown Voltage of Transformer Oil. By B. S. Ramaswamy, *N. V. Narayanaswami and F. N. Mowdawalla*. Pp. 69–90. 1.12 rupees. Vol. 17B, Part 5: Brush Contact Drop in D.C. Machines. By M. V. Kesavo Rao. Pp. 91–100. 1 rupee. (Bangalore: Indian Institute of Science.)

Hints to Prospectors and Owners of Treatment Plants. Sixth edition. Pp. 64. (Perth: Government Printer.) 9*d*.

National Research Council. Transactions of the American Geophysical Union, Fifteenth Annual Meeting, April 26, 27, 28, 1934, Washington, D.C., and Berkeley, California, June 20, 21, 1934. Part 1. Pp. 258. Part 2. Pp. 259–634. (Washington, D.C.: National Academy of Sciences.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 15: The Templeton Crocker Expedition to Western Polynesian and Melanesian Islands, 1933—Notes on the Reptiles and Amphibians, with the Description of a New Species of Sea-Snake. By Joseph R. Slevin. Pp. 183–188. Vol. 21, No. 16: The Templeton Crocker Expedition to Western Polynesian and Melanesian Islands, 1933—Notes on the Birds. By M. E. McLellan Davidson. Pp. 189–198. (San Francisco.)

Obras completas y Correspondencia cientifica de Florentino Ameghino. Vol. 13: Formaciones sedimentarias de Patagonia. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 999+7 plates. (La Plata.)

Province of Alberta: Geological Survey Division. Research Council of Alberta, Report No. 30: Geology of Central Alberta. By John A. Allan and Ralph L. Rutherford. Pp. iii+41+v+3 plates. (Edmonton: University of Alberta.) 1 dollar.

Sudan Government. Annual Report of the Gezira Agricultural Research Service for the Year ended 31st December 1933, relating to Experimental Results obtained in the Season 1932–33. Pp. xiii+183. (Wad Medani: Gezira Agricultural Research Service.)

Reports of the Newfoundland Fishery Research Commission. Vol. 2, No. 2: Annual Report, Year 1933. Pp. 117+12 plates. (St. John's: Newfoundland Fishery Research Commission.) 1 dollar.

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige. Undersøgelser i Grønland, Bd. 79, Nr. 10: The Godthaab Expedition 1928—Copepoda. By P. Jespersen. Pp. 166. (København: C. A. Reitzels Forlag.) 8.00 kr.

Publication of the Netherlands Geodetic Commission (Uitgegeven door de Rijkscommissie voor Graadmeting en Waterpassing.) Gravity Expeditions at Sea, 1923–1932. Vol. 2: Report of the Gravity Expedition in the Atlantic of 1932 and the Interpretation of the Results. By F. A. Vening Meinesz, with the collaboration of Prof. J. H. F. Umbgrove and Ph. H. Kuenen. Pp. iii+208+5 plates. Tables belonging to Gravity Expeditions at Sea, 1923–1932. By F. A. Vening Meinesz. Isostatic Reductions, Elevations and Corrections of Separate Zones. Pp. 61. (Delft: J. Waltman, Jr.)

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NATURE

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No. 3397 Vol. 134

CONTENTS

Human Biology and Politics

AT the beginning of his Norman Lockyer lecture to the British Science Guild on November 28, Prof. J. B. S. Haldane remarked that Sir Norman was fortunate in that "His work on the chemistry and physics of the sun, revolutionary as it was from the point of view of pure science, did not bring him into conflict with established interests either in religion or politics". In this respect, he and other astronomers are to be envied, for they are immune from many of the dangers and difficulties that beset anyone who serves a science which deals with living things.

The number of the editions of several recent popular books on astronomy can be taken as a measure of the layman's interest in this subject. The books themselves possess great intrinsic value, being models of what such books should be, but this is not the reason why they have become 'best sellers'. We may assume that it is because the layman eagerly seeks information that he does not possess, and because the magnificence of the heavens would seem to proclaim the glories of the Creator, that these books are so much in demand.

With biology, however, things are very different. Popular books on biology, though equally well written, have not the same appeal. They cannot have, for it is rare to meet a layman who, though readily acknowledging his complete ignorance of the chemistry and physics of the sun, has not very definite ideas about the application of biology to human affairs. The specialist is commonly neither required nor welcomed. Almost every year sees the publication of a new book on sex written by someone who disregards completely everything that biological science has to say on this subject. The germ theory of disease is regarded as mere foolishness by thousands, who look upon orthodox medicine as being sadly mistaken. Apparently the only people who tend to preserve an open mind on such matters as birth control, eugenic sterilisation or euthanasia, are to be found in the ranks of biology and medicine. The trained biologist, speaking or writing on the biology of man, inevitably encounters fierce antagonism.

It is obvious that a science of social biology must exist and must develop. Biology concerns itself with the individual and the group in relation to the habitat, with the conditions of the habitat in relation to the vital processes of the individual and the group, and with the distribution of biological types within a varying environment.

This has long been recognised by the medical profession, for, so far, the application of biology to human affairs has been almost entirely the affair of the medical sciences. That this is so is not surprising, for medicine deals largely with the sick, and with illness comes fear, and with fear a willingness to receive help. There is more research now being carried out in the name of medicine than in almost any other cause; the thought of cancer evokes the greatest terror. The only other organised body which is concerned with the application of biology is the eugenic group, but the weakness of eugenics lies in the fact that it addresses its appeal to the strong, to idealism rather than to fear. Moreover, many of its policies are as yet in conflict with public opinion.

Prof. Haldane's lecture, which has now been published*, deals with certain aspects of the results of this contact between human biology and politics. He argues that, as our knowledge of human biology increases, the need for experts—experts on human genetics, population, nutrition, housing, reproduction, for example—will become more and more acute, and expresses the view that it is undesirable that these shall be included in the ranks of medicine. The medical man should be concerned with healing and not with killing, and, in any event, any large increase in the personnel and duties of medicine must lead to an undesirable hypertrophy that must end in disaster. It is true to say that the expert on human biology need not be a medical man, but surely it is eminently desirable that the medical man shall regard himself as an applied biologist, for in dealing with the individual he must necessarily be dealing also with the group, the family, and with problems of nutrition, housing and reproduction. Even though there be non-medical experts for the construction of policies, the execution of these must surely be performed by the medical services. But one's opinions on a matter such as this are largely decided by the possession or otherwise of a medical degree.

Dealing with the problems of human reproduction and population, Prof. Haldane points out that the population of England is likely to diminish very greatly in the near future. The net reproduction rate for England is 0·75; and wherever this rate is less than unity, the population is bound to fall.

* Human Biology and Politics. (The Norman Lockyer Lecture, 1934.) By Prof. J. B. S. Haldane. Pp. 23. (British Science Guild, 6 John St., Adelphi, London, W.C.2, 1934.) 1s.

"The net rate is below unity throughout North-Western Europe, including France and Germany. It is near unity in central Europe, and rapidly dropping towards that figure in Italy and the Balkans. For example, the net reproduction rate in Bulgaria fell from 1·9 in 1903 to 1·3 in 1929, and is probably now very little above unity. In the United States it probably fell below unity in 1927. In the British self-governing dominions it is still slightly above unity, but approaching that figure. The position in the U.S.S.R. and Japan is entirely different. In 1926–7 the net reproduction rate of the former country was 1·7; that of Japan is also very high, though really adequate figures are lacking. It is of course probable that in both these countries industrialization will ultimately lower fertility, but there are as yet no clear signs of this tendency."

Prof. Haldane discusses the political consequences of a falling birthrate, and concludes that any catastrophic fall is undesirable and should be prevented. He suggests as a means to this end the institution of a system of family allowances and the establishment of a recognised minimum dietary. On the question of the quality of population, he deals with three policies that are commonly presented: the elimination of certain relatively rare and undesirable types, the encouragement of a differential fertility on the part of the various social groups, and the control of immigration. He shows that, in most cases, elimination through enforced non-propagation would only have a slight effect upon the incidence of the undesirable in the population, and concludes that the scope of negative eugenics as applied to physical defects is severely limited. He is opposed to the policy of wholesale sterilisation, which to him seems to be the policy of those who consider sterilisation to be a cheaper alternative to segregation. As a biologist, he is prepared to advocate the voluntary sterilisation of the possessors of a harmful dominant gene.

Prof. Haldane's lecture is remarkable not only for the variety and cogency of the argument, but also for the reason that, recognising his responsibilities, he deliberately suppresses many views that he is known to hold. Rather than parade his own preferences, he stresses those opinions, not necessarily his own, which enjoy a sufficiently general support to render them worthy of consideration not only by biologists but also by politicians of all shades of opinion. The lecture admirably represents a biological expression of the objects of the British Science Guild: "To promote the application of scientific methods and results to social problems and public affairs".

Clinical Medicine and Science

IN the anniversary address delivered before the Royal Society on November 30, the president, Sir Frederick Gowland Hopkins, devoted particular attention to the relation between clinical medicine and science.

After alluding to the extraordinary progress which atomic physics continues to make and the remarkable response of atoms to various forms of treatment, he pointed out that the subject he had chosen is of special interest to the Royal Society inasmuch as it has received large bequests to support original research in medicine devoted to improvement in the treatment of disease and the relief of human suffering. He illustrated the close relationship between practice in the wards and activity in the laboratory by two recent advances which, taken together, served in a sense as a text for the rest of his address.

The first of these was the investigation carried out by means of the oscillograph method by the Foulerton research professor, Prof. E. D. Adrian, with his colleague, Mr. Brian Mathews, on the electrical changes which take place in the brain, with the object of relating the potential changes in the brain with the changes in individual nerve cells. The rhythmic activities of the human brain recorded as a series of waves after passing through the skull were shown by this method to be temporarily abolished by concentrated thought such as that involved in mental arithmetic. Sir Frederick suggested that further development of the technique might serve the clinical investigator of the brain as the cardiograph has served those concerned with the heart.

The second example of the assistance given to clinical medicine by the laboratory is furnished by the study of the virus of influenza, in which Mr. Laidlaw, in collaboration with Drs. Andrewes and Wilson Smith, who had previously shown that influenza can be transmitted to the ferret, proved that the mouse can also be infected, and thereby made the approach to various aspects of the problem much easier. Such progressive research, due entirely to the laboratory, is of prime importance alike to clinical and laboratory medicine, and being inspired by clinical experience illustrates the now generally recognised interdependence of the ward and the laboratory.

Sir Frederick next dealt with the uneasiness apparently felt by some physicians with regard to the introduction of multitudinous laboratory methods into the domain of diagnosis. While it is an open question as to whether reliance on laboratory reports destroys the clinical sense, as some are inclined to believe, he instanced the objections raised to the use of the stethoscope when it was first introduced by Laennec, on the ground that it was fatal to the dignity of the physician and brought only discomfort to the patient. Although a few may still be inclined to regard each diagnostic aid from the laboratory with a similar distrust, it is to be hoped that the practitioner will be ready to avail himself of every diagnostic assistance without impairment of his clinical sense.

Sir Frederick then proceeded to give a historical sketch of clinical science based on the classification of Sir Thomas Lewis, who grouped its activities in three categories. The first was the discovery of disease, or a clear description of specific diseases or states, which has been the aim of enlightened clinicians ever since the escape of medicine from Galenic authority in the seventeenth century. The second was experimental work on clinical cases, and the third the application of physiological discoveries to human material. The ignorance of the medical profession as to the nature of disease when experimental study of it began and the Royal Society was founded was illustrated by the appalling treatment of its founder, Charles II, in his last illness, when Galenic teaching was still predominant. How William Harvey, the indisputable father of clinical science, who had a thorough contempt for the Galenic teaching of his contemporaries, would have regarded such treatment, is best left to the imagination.

It is noteworthy that of the 146 original fellows of the Royal Society in 1663, 24, or nearly one sixth of the whole, were medical practitioners, while only one outstanding physician, Thomas Sydenham, did not join it, doubtless owing to his hatred of theory and any kind of deductive speculation. Sydenham, who was a pioneer in the discovery of disease in Sir Thomas Lewis's sense, held that each disease was an entity apart from the particular patient, and taught that the clinician's task was to reduce diseases to certain definite species, as botanists were doing in the classification of plants.

Continuing his historical sketch, Sir Frederick pointed out that there was no outstanding advance in the theory or practice of medicine in the eighteenth century, and that it was not until the rise of the great French school in the early years of the nineteenth century that real medical progress took place. With the notable exception of Broussais, who vehemently opposed the doctrine of specificity, the principal physicians in Paris shared Sydenham's belief in specific diseases as entities, and classified them accordingly, but they added something to mere observation of symptoms

as a basis for their classification. Thus Bichat, who was a profound student of morbid anatomy, emphasised the importance of relating the specificity of each disease to the nature of the fundamental tissues attacked rather than to the disturbances in individual organs.

The views of Broussais, who rejected the conception of diseases as entities and insisted that disorders of function should receive more attention, were supported by the contemporary school of Vienna, which maintained that the task of the physician was to identify in the patient the various individual lesions of morbid anatomy.

Meanwhile, the leading English-speaking physicians, such as Addison, Bright and Hodgkin in London, and Graves, Stokes, Cheyne and Adams in Dublin, were bringing about real advances in clinical medicine by the clear demonstration of diseases and clinical states with which their names are associated.

The great movement in German medical thought which culminated in the middle of the nineteenth century was associated with a strong reaction against all claims of specificity based on the mere assembling of associated symptoms. Virchow in particular maintained that French and British ontology had impeded real progress in scientific medicine, and believed that with its destruction the use of a treatment falsely called specific would also disappear.

On the other hand, the doctrines of Sydenham and the leading representatives of the French school, among whom Sir Frederick omits to mention Bretonneau, to whom Trousseau was indebted for his views on specificity, were later confirmed by the discoveries of Pasteur, whose laboratory work did more to clarify medical thought than most of the doctrines emanating from the medical schools, inasmuch as he replaced a mysterious something by the highly objective micro-organism as the cause of certain infectious diseases. Sir Frederick, however, pointed out that the presence of bacillus or virus, though an efficient cause, is not necessarily a sufficient cause of a disease, and that the constitutional factor, on which much emphasis has been laid in recent years, must also be considered in the causation, especially in the case of non-infectious diseases, and is doubtless susceptible of analysis by modern methods.

In forecasting the activities of clinical science, Sir Frederick expressed his conviction that the scope for really controlled experiments applicable to the intact human body is limited. He suggested that there are relatively few experimental fields for clinical science besides those of cardiology and related subjects in which Sir Thomas Lewis is engaged, and the studies of Prof. Edward Mellanby on nutrition in relation to disease (see NATURE of December 1, p. 830). On the other hand, there are many wide fields in laboratory science, and particularly those of biophysics and biochemistry, the cultivation of which will continue to benefit medicine.

Sir Frederick deprecated the growing tendency in Great Britain and elsewhere to distribute the funds provided for medical research in the endowment of the clinic at the expense of fundamental biological science, as he is convinced that such a policy will sterilise advance. In support of this conviction, he quoted Charcot's dictum that the clinic "without scientific renovation soon becomes a belated routine and, as it were, stereotyped".

In conclusion, Sir Frederick expressed the hope that the Royal Society, though its special duty is the encouragement of pure science, will continue to endow whatever fields of research might at any moment promise to offer most help towards progress, whether in the narrow region of clinical science or in the wider regions of pure science.

Maison de la Chimie, Paris

THE inauguration of the Maison de la Chimie by the President of the French Republic, which had been postponed for a month owing to the assassination of the King of Yugoslavia at Marseilles, took place on December 1. An international gathering of unusual brilliance witnessed this important step towards the co-ordination of scientific endeavour. Twenty-four countries were represented, and among the delegates from Great Britain were Prof. H. E. Armstrong (Royal Society and Federal Council of Chemistry), Mr. W. A. S. Calder (Institution of Chemical Engineers), Prof. C. S. Gibson (Royal Society), Dr. T. A. Henry (Wellcome Research Institution), Mr. Emile Mond (Federal Council of Chemistry and Chemical Society), Sir Robert Robertson (British Government), Mr. Richard Smith, Mr. Edwin Thompson and Prof. J. F. Thorpe (Institute of Chemistry), Mr. Thomas Pearson, of the International Chamber of Commerce and Sir Robert Cahill of the British Embassy. An excellent copy of the painting by Sir Thomas Lawrence of Sir Humphrey Davy was given to the "Maison de la Chimie" by a group of English chemists, whilst Mr. and Mrs. Emile Mond presented a replica of the bust of Faraday, the original of which is at the Royal Institution.

In the large and imposing hall, which will serve as meeting hall for future congresses, speeches

were delivered by the French Minister of Education, by M. Behal of the Academy of Sciences, by Prof. E. Biilmann of Denmark and by Sir Robert Mond, emphasising the importance of the event and the debt which chemistry owes to Marcelin Berthelot, to whose memory the Maison de la Chimie is dedicated. It was, in fact, in 1927, on the occasion of the Berthelot centenary, that an international appeal was made for funds for the erection of a centre for chemistry in Paris. To this fund sixty-five countries contributed, the total amounting to 25 million francs ; £12,000 was contributed from Great Britain, of which £9,000 came from Sir Robert Mond. The French Government gave to the Centre the historic building of La Rochefoucauld d'Estissac, rue St. Dominique, just behind the Chamber of Deputies (Fig. 1). Since 1931, extensive alterations have been made to this building, and two new wings added (Fig. 2) so that it is now admirably fitted for its new functions, which are to provide a meeting place for scientific societies and congresses and to supply information which it hopes to place at the disposal of those engaged in every branch of chemistry.

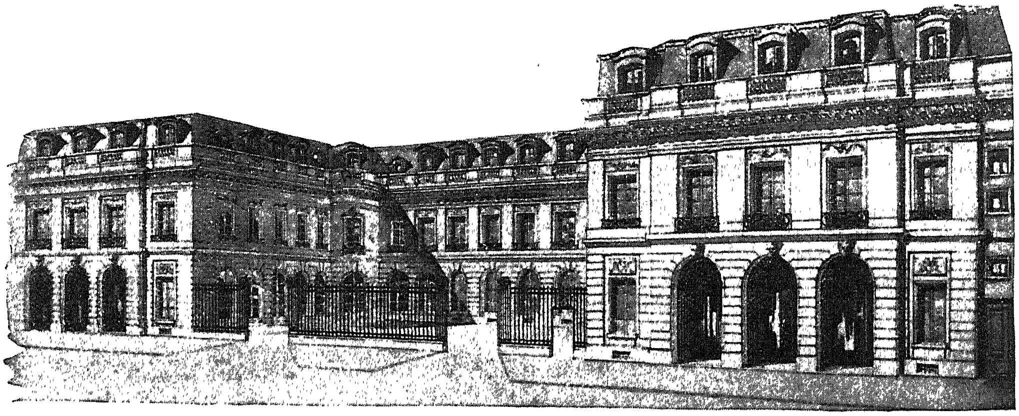

FIG. 1. Drawing of the front of the Maison de la Chimie.

Its organisation covers three spheres of action :

(1) The "Centre Marcelin Berthelot", which supplies facilities for meetings and offices for scientific societies ;

(2) A Centre of Chemical Documentation ;

(3) A Section of Technical Improvement.

With regard to the first, it is possible for a chemical society to have its own separate office within the building, or simply to have there a postal address and to share office facilities. Such affiliated bodies bring to the Centre their libraries. While remaining technically their property, the books are assembled and catalogued so that they are generally available. Each affiliated society pays about one shilling a year for each member for the facilities afforded to its members (*adherents*).

The services offered by the Centre as a meeting place are very extensive. There are reception rooms, committee rooms (for 20–50 people), conference rooms (for 35–100 people), banquet rooms where up to 500 people can be entertained, and a large congress hall which accommodates about one thousand. The amphitheatre with some two hundred individual seats has extensive facilities for chemical experiments, and several projection screens that can be used simultaneously. Microscopic, cinematographic and direct projection of

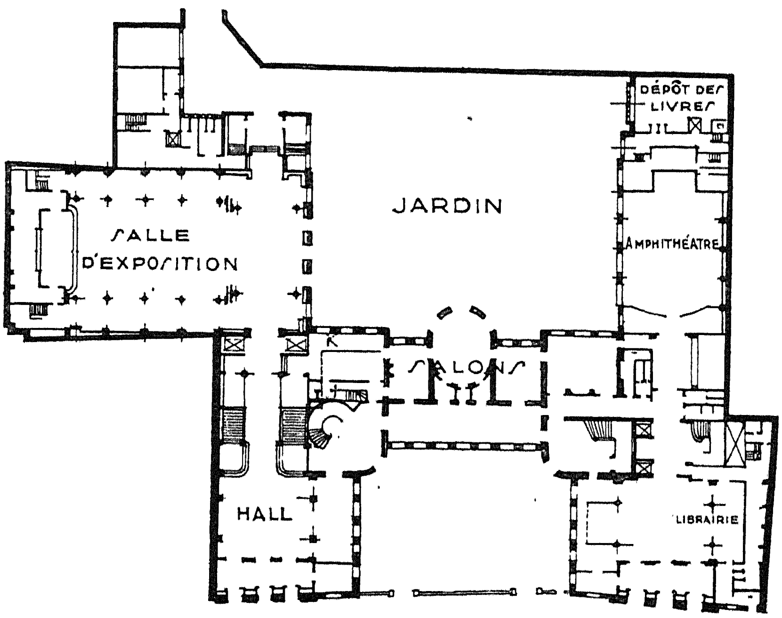

FIG. 2. Plan of the Maison de la Chimie.

experiments are all provided for. Individual microphones for the use of deaf persons can be connected to thirty seats, apart from the usual microphones used by the lecturer.

The Centre of Documentation aims not only at being a depository of all chemical knowledge, but also hopes to select, extract and arrange such knowledge in a manner that will render it most useful and most readily available to the individual investigator. It should be able to prepare fairly complete bibliographic information upon any chemical subject referred to it, supply photographic copies of the less easily available material, and translate matter from one language into another when necessary. It follows that the members of its staff will have to be highly trained, and many of them will need that particular flair that enables one to pick up from a large amount of material the essential facts that are likely to be useful in a given problem—by no means an easy undertaking, yet one which must be faced.

As regards equipment, the reading room provides at present for thirty readers, and is equipped with special optical and acoustical apparatus, since the library includes not only printed material but also films, gramophone records, etc. A glass partition separates the reading room from a smaller 'conversation' room, also provided with telephones.

The abstracting of scientific papers, patents and other documents and the compilation of bibliographies is carried out in the Ludwig Mond Hall, on the third floor of the building. This department can draw upon the bibliographical resources of many other organisations in addition to those of the Maison de la Chimie. This last is affiliated to the Union française des Organismes de Documentation, the task of which is to co-ordinate the great libraries of Paris.

The third section of the Maison de la Chimie is the Centre of Technical Improvement (Centre de Perfectionnement technique), which aims at keeping industrial chemists and others in contact with the latest developments in science. This it does by means of special courses of lectures and exhibitions. Several such series of lectures have already been arranged, dealing with new types of materials, the organisation of industry, etc.

The success which has attended the centralisation of chemical documentation and facilities in the Maison de la Chimie has opened even wider horizons. A "Cité des Sciences" is now being suggested, which would bring together all branches of science, act as a link between them, co-ordinate their discoveries and render them available to workers in every field, and strengthen the international bonds which bind together all those engaged in scientific work.

Many people have helped to bring about the successful completion of the Maison de la Chimie, but there can be no doubt that credit rests largely with its active *administrateur*, M. Jean Gérard, to whose vision and energy every one of those present at the inauguration paid a well-deserved tribute. M. Gérard has been for many years the secretary of the International Union of Chemistry, takes an active part in the editing of *Chimie et Industrie* and is president of the Union française des Organismes de Documentation (corresponding to ASLIB in Great Britain).

Large-Scale Plans of Great Britain

IT is a widely accepted fact that, since the War, the national large-scale plans of Great Britain have been getting more and more out of date. The reductions of staff, effected as a result of the recommendations of the Geddes Committee of 1922, have made it impossible for the Ordnance Survey to keep the plans in a reasonable state of repair. This is all the more to be regretted because the reductions in question only produced a trifling economy in the national budget. A leading article discussing the present position was published in NATURE of November 3, and if, as we may hope, an inquiry is to be held into this matter, a recent publication by the Director of the Ordnance Survey* will provide a sure foundation of fact upon which it can be based.

* Ordnance Survey. Professional Papers, New Series, No. 16: The National Plans (The Ten-Foot, Five-Foot, Twenty-five-inch, and Six-inch Scales). By Brigadier H. St. J. L. Winterbotham, Director-General of the Ordnance Survey 1934. Pp. 112+27 plates. (London: H.M. Stationery Office, 1934.) 4*s*. 6*d*. net.

A list of some of the headings of the sections of the report will serve to give an idea of its character. We find amongst these headings :—early British property surveys ; foreign analogies ; city scales ; first revisions ; a pre-War stocktaking ; reductions [of staff] ; co-ordinates and sheet lines ; levels and bench marks ; areas ; boundaries ; the name book ; air revision ; plans for registration ; plans for land valuation ; surveys for tithes, and other interesting matters.

Brigadier Winterbotham rightly says that, in the main, the history of the Ordnance Survey in the century before this year, that is, since 1834, remains to be written, and he remarks that the history of our large-scale plans is particularly vital. "The times are difficult. Short cuts and next bests suggest themselves in a variety of ways. It is time to take stock of where we are going."

Two generations ago, a commission of inquiry

gave a list of seventeen purposes which come properly within the scope of a national survey, and to this number we may now add four more at least, namely, town and regional planning, the conveyance of property, land registration and land valuation. Here it is very appropriately pointed out that, chiefly as the result of Colby's foresight in 1825, it has always been the custom on the British large-scale plans to depict the actual physical features of the countryside on which the property boundaries depend, and not the boundaries themselves. "There seems to be no foreign analogy for the use in property questions of a map which shows no property boundaries as such. But then, in England, whether the actual boundary is coincident with the wall, fence or hedge, or not, the owner and his neighbours know at once from his enclosures what land he actually makes use of" . . . "A purchaser going upon the property he is about to buy, with an accurate plan in his hand, can, in nine cases out of ten, identify the thing which he is buying with as much ease and certainty as if he had lived upon it all his life."

A good account is given of the city scales, namely, those of 1 : 500, often called the ten-foot scale, the 1 : 528, which is the true ten-foot scale, and the 1 : 1056 or five feet to the mile. These are beautiful and elaborate plans, executed on these various scales between 1843 and 1894, when they were discontinued by order of the Treasury, except in cases in which the local authority agrees to pay the extra cost involved as compared with the cost of the twenty-five inch plans. The last case of the kind was the Leeds survey of 1909–10, so that the arrangement nowadays is practically obsolete. For land registration, elsewhere than in London, enlargements of the 1 : 2500 to 1 : 1250 are used—not a perfect solution, but inexpensive.

The work contains much well-described technical matter, and will give an idea of the complexity of some of the problems dealt with. It may also serve to show that many of these problems have been discussed and examined at various times during the past century. But of course there are also new methods, and among these we may note the use of air photographs for large-scale revision. Various experiments have been made, chiefly with the view of seeing if economy would thereby result in the revision of the twenty-five inch plans. The question is not being allowed to drop, but it looks as if "town air revision may pay and country work certainly not". But much must depend upon the cost of the air photographs. The matter is not quite so straightforward as it might seem.

The report is well-illustrated. We find comparisons of the plans of twenty years ago and more with those of to-day. Examples are given of maps prepared for the Land Registry and of surveys for tithe redemption ; and there are several interesting graphs which illustrate the amount of time spent on different classes of work. There is a useful chronology extending from 1820 to the present year. Indeed, anyone who desires to be correctly informed as to the many social and technical aspects of the national large-scale plans cannot do better than consult this work.

This is the first thorough account of the large-scale plans of the Ordnance Survey that has ever been published, and many of those—and their name is legion—who use and appreciate these plans, will feel that they owe the present Director-General their hearty thanks for having placed this valuable history and description within their reach.

Obituary

PROF. SANTIAGO RAMON-Y-CAJAL, FOR.MEM.R.S.

THE microscopy of the nervous system had, by the latter half of last century, grown into something of a special study. It relied on its own votaries, not many but distributed world-wide. Fellowship in their somewhat recondite pursuit united them quasi-socially into a sort of family, a family not shrewdly discontent with its own achievement nor indeed gravely perturbed by a slowness of progress which seemed to challenge eternity. Upon this pedestrian tradition, when the century entered its final decade, burst suddenly an astonishing Spanish master. Santiago Ramon-y-Cajal of Valencia was then close on forty years of age. From the Pyrénnean slope, in a mountain village, where his father practised among the peasants, he had, when his parents moved, with their bare savings, to Zaragoza, been little of a success at school. So little in fact as to be twice withdrawn thence, once to assist a barber, and once again for apprenticeship to cobbling. He did cobbling well, but his father's ambition cherished the scalpel for him, though the boy's own pleading was for paint-brush and pencil. In after years indeed he substantiated his gift for draughtsmanship when his drawings became familiar to students the world over. Other recorded likings of the recalcitrant schoolboy were at that time the watching of birds and the reading of travels, and of these latter as primo favourite "Robinson Crusoe".

To anatomy, however, Santiago eventually settled down, under his father, its teacher at the University. Ramon senior was planning an anatomical atlas ; for this, his son made drawings ; but no publisher was found. Following medical study came military service, in Cuba, where he contracted malaria and tubercle. He returned after slow recovery to Zaragoza, this time as anatomical assistant. He secured his doctorate ; in 1884 he gained the chair of anatomy at Valencia. There in his house he installed a microscope and a tiny laboratory. He examined nerve

tissue. Chick, earthworm, mouse and lizard served for material. He worked in isolation, with an urge amounting to a fury of curiosity and enthusiasm. He extended his technique on lines of his own, suggested from photography. Expense hampered him; he would mount on a single slide a dozen different things. He could afford no illustrations save his sketches. But he made his observations with a fidelity and an understanding which as the world now knows were supreme.

Cajal's observations sometimes would not tally with accepted views. The dense thicket of minute fibres in the grey matter of the brain and spinal cord was regarded at that time as a reticulum, a network of unbroken continuity spread homogeneously in its several directions. It was interpreted functionally as being either diffusely conductive or perhaps simply trophic, serving to nourish the cells scattered in it. The more Cajal examined this thicket the more did it seem to him clearly resoluble into discrete many-branched nerve cells linked on a definite plan into perfectly determinate chains. Moreover, the direction of nervous conduction along these chains he found could be read ("ley di polarizacion del cellula nervosa") by noting certain features repeating themselves from cell to cell. He had in fact analysed the brain and the nervous system generally, vertebrate and invertebrate, into branching cell-chains, chains, in electrical parlance, arranged both in series and in parallel. He traced the main paths through the grey matter of the optic lobes (birds), the retina, the cerebrum, the cerebellum and the spinal cord.

The fresh conception thus established and placed on a factual basis by Cajal was presently christened, by one who had no hand in its making, the 'neurone theory', a little unwelcomely to Cajal. Cajal's recognition of the morphological discontinuity between cell and cell in the nervous system, agreeing as it did with observation of the cell limits given by Wallerian degeneration, had repercussions on the sister-study, physiology. It led indirectly to the functional conception summed up under the term 'synapse', a term adopted by Cajal. From Cajal derives therefore more or less directly even that latest phase of nerve study, in the forefront of discussion to-day, which asks whether the mechanism of the synapse, that is, the mode of transmission of excitement from one nerve cell to another, is in nature chemical or physical.

Somewhat similarly, under Cajal's analysis, that hitherto difficult tissue which supports and imbeds the active nerve cells throughout the brain and cord resolved itself into separate cells of clearly distinctive subtypes, and with specific fibres of their own. His study of these cells laid the basis for a classification of them, and so incidentally of the modern classification of tumours of the brain, to which unfortunately this supporting specialised tissue makes large contribution.

In 1894, at invitation of the Royal Society, Cajal delivered in London the Society's Croonian Lecture. This recognition was an early satisfaction to him, and its recollection remained a pleasure with him all his life. His work suffered some disadvantage from being published in Spanish. This disability grieved him, less for himself than as a mark of the scanty scientific intercourse of Spain. The periodicals which contained his early discoveries did not get access to libraries in the British Isles. He felt passionately this relative scientific isolation of his country. He laboured unremittingly for Spain to be better equipped in science and for Spanish contributions to science to be better known internationally. His endeavour in those directions has, as we know, been not without success, but has scarcely met in some directions with due assistance from outside. To judge by the present "World List", those periodicals which published his discoveries first are now, forty-seven years later, still not on the intake-list of any scientific, medical or university library in the British Isles. In our library system, extravagant overlap of foreign intake in some directions is coupled with inadequate foreign intake in others. Such lag in dissemination of discovery, as happened with Cajal—and with Gregor Mendel—will assuredly recur, with all its disabilities for us, until such time as our libraries co-ordinate better their foreign intake by revision and sisterly co-operation.

Promoted to Madrid (1892), Cajal there formed a great school. It sent forth famous pupils; to name but a few: the brilliant Achúcarro, early cut short by death; Rio Hortega, the foremost authority on neuroglia; Tello, now head of the Instituto Cajal itself; Lafora, the accomplished physiologist; and, among later disciples, Wilder Penfield, distinguished director of the new Institute of Neuro-Surgery at Montreal. Cajal founded his *Rivista* in 1896, continued as *Trabajos* in 1901. He produced his extensive "Textura del Sistema Nervioso" (1897–1904). He visited the United States to lecture at Clark University. In 1906 he was awarded the Nobel Prize. His period of productivity was long. His latest large work was an amplified edition (1928) in English of his "Degeneration and Regeneration of the Nervous System". Only last year came his masterly little "Neuronismo o Reticularismo", a summary of conclusions on the question he had so early raised, and settled. He died in mid-October of this year at the ripe age of eighty-three years.

Cajal's position in his own country had for many years been one of universal veneration. His opinion was sought on educational matters by authorities of all parties. He had become a national figure, an object of national pride. He was regarded indeed as a kind of living symbol of the scientific aspirations of a new and renascent Spain. His statue is prominent in the Buen Retiro Garden in Madrid. The celebration of him by the million-fold portrayal of a postal issue was proposed, but 'the Master' deprecated the proposal, and it fell through. We cannot, however, but think that, posthumously revived, such a memento, at once national and democratic, would have touched Don Santiago's heart. Be that as it may, the very proposal shows the position accorded to him in the Spanish world, a position accorded him with the sympathy and applause of the civilised world entire.

C. S. S.

SIR VINCENT EVANS, C.H.

WE regret to record the death of Sir Vincent Evans, the well-known authority on Welsh history and antiquities, which took place in his eighty-eighth year at his residence at Chancery Lane, London, on November 14.

Evan Vincent Evans was born at Trawsfynnydd, Merionethshire, and after a period as schoolmaster, entered business. He came to London and eventually was appointed secretary, and later managing director, of the Chancery Lane Land and Safe Deposit Co., a post which he held until within a few months of his death.

Evans was inspired—no other term is fully appropriate—with an intense devotion to Welsh studies, and from the time he came to London was in touch with, and soon became one of the leaders of, Welsh circles in which a keen interest was taken in Welsh language, literature, history and antiquities. In fairness, it must be said that he soon became the main driving force which kept this interest alive and extended and strengthened its influence. He played a large part in the efforts to assure the official recognition of Celtic studies and the care of Welsh antiquities. His early efforts in this direction found expression through the Honourable Society of Cymmrodorion, of which he was secretary and editor of publications, including its periodical, *Y Kymmrodor*, and the National Eisteddfod Association, of which he became secretary and editor in 1881. Both these positions he retained until his death. His activity in administrative and editorial work was prodigious. Through his enthusiasm, and his power to inspire enthusiasm in others, he made the Cymmrodorion the most influential body, and its periodical *Y Kymmrodor*, as well as its other occasional publications, the most authoritative source in the study of Welsh history and antiquities, while through the National Eisteddfod Association he revived and fostered interest in the Welsh national gatherings and made them effective in promoting the development of modern Welsh literature and art.

Sir Vincent Evans's organising ability, his wide knowledge and his acquaintance with everyone interested in his subject, inevitably made his assistance indispensable in all academic and public movements connected with Welsh studies. He was chairman of the Royal Commission on Ancient Monuments in Wales and Monmouthshire, and of the Advisory Board of Ancient Monuments (Wales). He represented Wales on the Royal Commission on Public Records. He was a governor of the University of Wales and of its constituent colleges at Aberystwyth and Bangor. He was also a governor of the National Library and of the National Museum, as well as a member of the Board of Celtic Studies. He was for long active in the administration of the business of the Cambrian Archæological Association. In 1909 he was knighted for his services to Wales, was made a Companion of Honour in 1922, and received the honorary degree of LL.D. from the University of Wales.

WE regret to announce the following deaths:

Prof. Collier Cobb, professor of geology in the University of North Carolina, an authority on moving sands and shore line processes, on November 28, aged seventy-two years.

Sir Horace Lamb, F.R.S., lately professor of mathematics in the University of Manchester, on December 4, aged eighty-five years.

News and Views

Queen Mary College

ON December 12, H.M. the Queen is to present at Buckingham Palace the Royal Charter incorporating the East London College (University of London), and with this incorporation the College changes its name to Queen Mary College. The incorporation of the College has long been planned by the Council of the College and by the late principal, Mr. Hatton. It confers upon the College many powers and privileges which it has not in the past enjoyed. As an incorporated College of the University it becomes entirely independent of the Board of Education, and also acquires unrestricted ownership of the property vested in it, which includes the site of the Queen's Hall and Winter Garden, London, E., previously the property of the People's Palace, with which, and the Drapers' Company, the College has for many years had very friendly relations. The site of these buildings, which suffered from a fire a few years ago, will now be available for building extensions which the College has long required. The Charter also gives the College the power to confer honorary fellowships, and the Queen has graciously consented to be the first honorary fellow of the College which is to assume her name.

THE change of name of East London College has been felt desirable because the territorial designation in no way indicated the true functions of the College, which draws its students from all parts of the country and from abroad. It was desired to preserve the association with the queens of England which was begun by the laying of the foundation stone of the original technical school by Queen Victoria in 1887. The College was admitted as a school of the University of London in 1907, and throughout its career it has acquired a reputation for a high standard of work both in teaching and research. The College has for many years presented students for all degrees of the University covered by its curriculum, and its students have shared the academic honours of the University equally with those of the other colleges. The authorities of Queen Mary College hope that the great opportunity for extension which now presents itself will enable the College to provide more ample scope for teaching and research, and

will inspire further benefactors to give it the means to go forward with the work of placing the higher branches of knowledge within the reach of "persons of the poorer classes".

Portrait of Sir Flinders Petrie, F.R.S.

On Sir Flinders Petrie's retirement from the Edwards professorship of Egyptology in the University of London, many of his friends and admirers desired to commemorate his long tenure of that chair. It was decided that the memorial should take the form of a portrait of the great pioneer in the science of archæology, to be presented to University College, where he had worked for forty years. An appeal for subscriptions met with a generous response and, on Sir Flinders Petrie's visit to England in the summer, the portrait was painted by Mr. Philip de Laszlo. On November 23, Sir Henry Lyons made the presentation to the College on behalf of the subscribers, of whom a large number were present; Sir John Rose Bradford accepted the gift on behalf of the College. The portrait is an exceptionally fine example of the artist's work and a striking likeness of Sir Flinders Petrie.

In presenting the portrait to the College, Sir Henry Lyons referred to the debt to Sir Flinders Petrie of archæology in general and Egyptology in particular. He recalled that during the forty years Sir Flinders has been connected with the College, he has combined the duties of teaching with work in the field, at first and for long in Egypt and afterwards in Palestine. He has applied the method of exact measurement and scientific observation, which he employed in the investigation of the ancient monuments of Great Britain, to the study of the monuments of Giza, so that not only have his measurements of the pyramids been the first observations of exact value, but they have been fully confirmed by the measurements made much later under far more favourable conditions by the Survey of Egypt. From both Egypt and Palestine he has brought back a harvest of material objects and recorded observation, of which the prompt publication was his first care. In the application of scientific methods to archæological investigation he has been a pioneer and his methods have been adopted and extended by those whom he himself had trained and by others. Here Sir Henry might well have referred to Sir Flinders' elaboration of the system of sequence dating which has remained the principal means of scientific chronological analysis in archæological investigation ever since he first formulated it, and is largely responsible for the great advances in recent archæological exploration in the near East to which Sir Henry went on to allude. All archæologists will cordially concur in the note on which he concluded, when he spoke of Sir Flinders as an inspiring teacher, who has brought home to a wider public "the interest and importance of Ancient Egypt in human history", and as one who well merits this record in the College in which he has worked.

Dr. C. E. Guillaume

The degree of doctor *honoris causa* of the University of Paris was conferred on M. C. E. Guillaume, director of the Bureau international des Poids et Mesures at Sèvres, on November 10, in course of the annual meeting held at the reopening of the University, with M. Charlety, the rector, presiding. The inauguration address was read by the dean of the faculty of sciences, Prof. Maurain. M. Guillaume, a Swiss citizen, has been doing work in France for nearly fifty years at the Bureau international, first as assistant, and for twenty years as director. A fervent metrologist, M. Guillaume has fostered every improvement likely to increase the accuracy of the measurements. His painstaking investigations in thermometry and in the measurement of length made him look for possibilities of diminishing the effects of temperature. Hence followed a laborious research on special alloys, which led to the discovery of his famous 'invar', a nickel alloy of which the coefficient of expansion is practically negligible. But metrology did not monopolise M. Guillaume's thoughts. A good many people have enjoyed reading his "Initiation à la mécanique", a pleasant booklet reflecting the leading ideas in physics at the beginning of the twentieth century. Besides purely scientific work, M. Guillaume has done much to further the use of the metric system, as a means to ensure international collaboration. As the Director of the Bureau international, created in 1875, M. Guillaume has had the satisfaction of seeing the system adopted even in oriental countries such as the U.S.S.R., Japan, Turkey, Persia, Afghanistan, Siam, Iraq and China. His report to the International Conference of Weights and Measures in 1933 dealt with the "Recent Progress of the Metric System" and raises the hope of the early and universal adoption of this system.

Broadcast of the Royal Wedding Service

The broadcasting of the wedding service of H.R.H. The Duke of Kent and Princess Marina from Westminster Abbey on November 29 was described by the *Times* wireless correspondent as an unparalleled technical feat of the B.B.C. engineers. All who listened on this occasion will agree completely with this opinion; while those whom circumstances compelled to wait for the re-broadcast of the ceremony in the evening programme will have been equally impressed by the very high quality of the recording and reproducing technique. A brief description of the technical arrangements adopted for this occasion was given in *World Radio* of November 23, from which it is quite clear that the wireless listener was in a much better position, so far as hearing was concerned, than were probably most of those who attended the wedding service in the Abbey itself.

Fourteen microphone circuits were installed in suitable locations in and near the Abbey, and were connected to a control room installed in the crypt.

The microphones used were of the moving coil type and, with one exception, they were carefully hidden. The engineer responsible for the arrangements sat in the crypt operating the controls for the various microphones required for the different portions of the ceremony, ranging from the running commentary outside the Abbey to the actual service at the altar steps. The various circuits were faded in and out so smoothly that the impression conveyed to the listener was that only one microphone was being used, and that it was being transferred from point to point as required. Four special telephone circuits were established between the control room and Broadcasting House, and from the latter centre the programme was distributed through all the home and Empire broadcasting stations. The developments of broadcasting and communications technique during recent years were utilised in the above manner to make this wedding ceremony an outstanding event in history; for, as the Archbishop of Canterbury remarked in his address, never before has a marriage been attended by so vast a company of witnesses.

An Experimental Railway Journey at High Speed

ON November 30, the London and North Eastern Railway made an experimental run with a train from London to Leeds and back, to demonstrate what the possibilities were with steam as compared with oil. For the outward journey, the train was made up of locomotive No. 4472, a 'Flying Scotsman' engine, with a dynamometer car, a first-class corridor coach, a dining car and a brake van, while for the homeward journey two other corridor coaches were added, increasing the weight behind the engine from 145 tons to 205 tons. The train left King's Cross at 9.8 a.m. and arrived at Leeds at 11.39 a.m., the distance being 185·7 miles and the average speed being 73·4 miles per hour. The return journey was begun at 2.0 p.m. and ended at 4.37 p.m. During the return run, between Grantham and Peterborough, a maximum speed of 100 miles an hour was recorded, while during the climb from Tallington to Corby the speed was never less than 80 miles per hour. The experimental run was intended as a test of the steam locomotive burning coal on a service similar to that now run in foreign countries by trains with Diesel-engined locomotives. The most notable of these trains at the present moment is the *Flying Hamburger*, which covers the distance between Berlin and Hamburg daily at an average speed of 77 miles an hour. The line over which the *Flying Hamburger* travels is level and without curves, while the line between King's Cross and Leeds has gradients up to 1 in 100, and several speed restrictions. Such a passage as that made on November 30, of course, could not be made without a certain amount of dislocation to other traffic and it was expensive; but it showed that the potentialities of the steam locomotive for high-speed work have not been exhausted. It is noteworthy that the engine used is stated to have run some 44,000 miles since its last overhaul.

Launching of Long-Range Aeroplanes

INVESTIGATION into the possibilities of a new method of overcoming the difficulties of taking off with fuel sufficient for a long flight together with a reasonable amount of useful load, will shortly be carried out under the auspices of the Air Ministry and Imperial Airways by the use of a 'composite seaplane' now being built by Messrs. Short Brothers of Rochester. The machine is a flying boat, with sufficient initial climb to be able to take off the water easily with an exceptionally heavy load. The major portion of this load is a high-speed float seaplane, the design characteristics of which are those required for economical long-distance flight. It is carried practically on the wings of the flying boat, from which it can be released when sufficient speed and height are attained. The power of both of the machines is used for taking off. For this experiment a small single-engined seaplane will be used, which will probably not be seaworthy enough to weather rough water on the open seas if compelled to alight. It is, however, capable of flying to the Azores under normal conditions, and in the rarely favourable case of a continuous following wind, even to fly the whole of the direct crossing to America. The problem of securing exceptional range has hitherto been dealt with by refuelling in the air immediately after starting. The operating aircraft takes off with a small fuel load and is then filled from a 'tanker' machine, by means of a trailing hose picked up and connected while in flight. This system has been developed successfully by the R.A.F., but has never been used extensively for either military or commercial purposes.

Airship Developments in the United States

ACCORDING to Science Service, of Washington, D.C., one of the older U.S. naval Zeppelin airships, the *Los Angeles*, has been reconditioned and made fully airworthy for a series of experiments upon mooring. It will be maintained in ordinary flying condition and moored out of doors, in the usual way, for at least a complete year. Experience thus gained will help to settle a number of questions upon which it is impossible to theorise. These include estimation of the velocity and extent of winds and gusts, the behaviour of the airship when under the effects of these and other meteorological conditions, the best handling of the ship to counteract the adverse effects of such, taking on supplies, fuel, etc., development of the ideal mooring system, and methods of docking into a hangar. Such information should be obtained with greater expedition and safety, using a trained experimental staff in this way, than endeavouring to gain similar experience during the normal using of the airship in service.

Development of Cargo Vessels

The seventh Thomas Lowe Gray lecture to the Institution of Mechanical Engineers was delivered on November 30 by Mr. L. St. L. Pendred, who took for the title of his lecture "A Survey of Ships and Engines". Although, in the first part of his lecture,

Mr. Pendred recalled some of the historic vessels and a few of the notable inventions connected with marine propulsion in the early days of steam navigation, he avoided the well-trodden path which leads to the epoch-making ships connected with ocean travel or with fighting fleets, and turned aside to consider the development of ships designed especially for cargo carrying. These he said are "the lesser vessels which do the come-day go-day work of the world; the tramps and freighters slogging their patient way across the Bay, facing typhoons in the China Sea, picking their courses 'twixt Scylla and Charybdis, nosing themselves into little ports looking for cargoes; never certain where next their lawful occasions may take them". By means of curves of tonnage, horse-power, speed, steam pressures and the like, he endeavoured to show how, in these as in all ships, economy has been attained. In 1887 a typical tramp had a displacement of 4,840 tons; in 1896, 7,075 tons; in 1911, 10,000 tons and in 1928, 12,380 tons; and during this time the coal consumption per knot per ton dead weight carrying capacity had fallen 40 per cent. To those who would call a halt to invention he said, "not the wills of all the anti-mechanization people in the whole world will check for a fraction of a second the wheel that began to spin a hundred and forty years ago when James Watt produced the rotative steam engine". Further economy in cargo ships must be and will be sought.

The Waitaki Hydro-electric Installation, New Zealand

THE opening on October 26 by Lord Bledisloe, Governor-General of the Dominion of New Zealand, of the hydro-electric power station near Kurow, on the Waitaki River in the South Island, was the occasion of an imposing ceremony attended by the Prime Minister (the Right Hon. G. W. Forbes) and other ministers and public men. It was a noteworthy event in the annals of the country, being the inauguration of the largest installation of water-power so far developed there. The following brief details of the undertaking are extracted from the *Wellington Evening Post*. The total length of the impounding dam is 1,800 ft., with a spillway 1,200 ft. long. The structure, which contains half a million tons of concrete, has a maximum height of 120 ft. and a base width of 145 ft. The power house, 350 ft. long, 150 ft. wide and 130 ft. high, is an integral part of the dam and provides for the reception of five turbo-generators, each of 23,000 horse-power, of which only two, as yet, have been installed. Lord Bledisloe in his address said that electric supply is available to no less than 94 per cent of the total population (a percentage probably not exceeded in any other country in the world) with an average consumption per capita of about 500 units per annum. The total capital invested in electrical supply undertakings in New Zealand is £32,000,000, of which £28,000,000 has been expended during the last eleven years. During the same period, Government expenditure has amounted to £10,500,000. The average cost of current for ordinary domestic purposes is 1·31*d*. per unit as compared with 1·30*d*. in Great Britain and 1·39*d*. in the United States. Lord Bledisloe urged a fuller recognition of the complementary possibilities of user on the part of urban and rural consumers, and the extent to which one could assist the other.

Mangarevan Expedition of the Bernice P. Bishop Museum

ON October 28, Bernice P. Bishop Museum welcomed the natural history party of the Mangarevan Expedition returning to Honolulu aboard the specially designed sampan *Islander* from six months' field work in south-eastern Polynesia. The Mangarevan Expedition was organised for the exploration of little-known islands and atolls in extreme south-eastern Polynesia. Of the thirty-one islands and many atolls and reefs on which the party landed, particular attention was given to Anaa, Napuka, Tatakoto, Hao, Mangareva, Timoe, Pitcairn, Henderson, Oeno, Rapa, Raivavae, Rurutu and Rimatara. Surveys supplementing those made by Bishop Museum in previous years were conducted at Tubuai, Tahiti, Raiatea, Huahine and Borabora. To gain access to atolls and cliff-bound volcanic islands, a ship of high power and shallow draught was designed, and to permit the party to divide its forces for particular kinds of work, a transfer ship and power launches were provided. The expedition was made possible by generous grants from the Rockefeller Foundation and from institutions and individuals in Hawaii. Regarding the expedition, Prof. Herbert E. Gregory, director of Bernice P. Bishop Museum, remarks: "Under the experienced leadership of Dr. D. Montague Cooke, ably supported by Captain William Anderson of the *Islander*, the program of the expedition was carried out with marked success. The collections, which include some 15,000 sheets of plants, 40,000 insects, 160,000 land shells, and representative series of other animals, is sufficient to give a fairly complete picture of the land fauna and flora of the southeastern Pacific, and to indicate the relation of the oceanic islands to South America. The expedition practically completed the general survey of the ethnology and natural history of Polynesia which has been the chief interest of the Museum since 1920."

Third International Locust Conference

IT is not unusual for proceedings of international scientific congresses to be published some months, or even years later, but this cannot be said with regard to the Third International Locust Conference held in London in September (see NATURE, **134**, 484, Sept. 29, 1934). The volume of its proceedings was issued by H.M. Stationery Office two months after the Conference. It is a very compact publication which contains in its 184 pages a mass of first-hand and thoroughly up-to-date information on the locust problem. The official part of the proceedings occupies only a relatively small portion of the volume, while the bulk of it consists of papers presented by various experts. The papers deal with all sides of the locust problem in a very brief and concise manner, discussing the most important points to be investigated

and the methods of doing it. The set of resolutions adopted by the Conference, and printed in English and French, presents a mass of very detailed and valuable recommendations for future research. Although the Conference was concerned only with the locust problem in Africa and western Asia, the resolutions should be of great assistance in all countries where the locust problem is studied, because many of the recommendations with regard to the organisation and methods of research are applicable to any country. In view of the recent disastrous developments in the locust situation in South and North America, Australia and China, the work of the London Conference will undoubtedly have a world-wide appeal. It has laid a firm foundation for the international scientific attack on the locust problem and the main task of the next Conference, to be held in 1936 in Cairo, will be to extend the existing anti-locust front to all the countries suffering from these pests.

Imperial Agricultural Research

THE fourth annual report of the Executive Council of the Imperial Agricultural Bureaux, recently issued, continues the story of the smooth and successful working of an Imperially controlled and financed organisation (Imperial Agricultural Bureaux. Fourth Annual Report of the Executive Council, 1932–1933. Pp. 23. (London: H.M. Stationery Office, 1934.) 1*s*. net). The period under review marks the end of the two years' term of office of Mr. F. L. McDougall, the representative of Australia, as chairman of the Council; and for the next two years Sir Charles J. Howell Thomas, the United Kingdom representative, has been elected chairman, with Mr. Nevill L. Wright, New Zealand, as vice-chairman. The most important event in the year was the inquiry made into the work and organisation of the Bureaux, in common with that of other inter-Imperial organisations, by the Imperial Committee on Economic Consultation and Co-operation, appointed as a result of one of the resolutions of the Ottawa Conference. That committee of inquiry not only recommended the continuance of the work but also accepted the organisation as a general model for inter-Imperial organisations and proposed that additional duties be placed on the Council. The main functions of the Bureaux are the collecting, sifting and distributing of information on research in eight branches of agricultural science; and the nine abstract journals already started have now become well established. In addition, a number of reviews with bibliographies on special subjects have been published, and the issue from Weybridge of the "Index Veterinarius"—a compete index of all papers and publications on veterinary science—has been sanctioned.

Physical Investigation of 'Immaterial' Bodies

THERE has recently been published by the Dr. William Bernard Johnston Foundation for Psychological Research, Reno, Nevada, a pamphlet by R. A. Watters entitled "The Intra-Atomic Quantity". Mr. Watters describes a series of experiments in which grasshoppers, frogs and mice were killed in a Wilson expansion chamber, a cloud produced at the moment of death, and the resulting 'tracks' photographed. It is alleged that these photographs reveal forms corresponding in shape to the dead bodies, and it is claimed that this result demonstrates the existence of an "intra-atomic Quantity" which is an "immaterial body" and an "exact counterpart of the physical body to which it belongs". It is further claimed that when the subjects of the experiments were removed from the Wilson chamber and gave any signs of life, the photographs never showed anything unexpected; but that when the photographs showed 'intra-atomic' tracks, the subjects were unquestionably dead. Unfortunately, the few photographs reproduced in the bulletin before us reveal the alleged markings only to the eye of faith; for the rest, the essential experimental details are almost wholly wanting. If Mr. Watters wishes his work to receive attention, he should publish a more adequate and a more fully illustrated report.

Calculating Machine for Simultaneous Equations

THE calculating machine for the solution of differential equations constructed by Dr. V. Bush, of the Massachusetts Institute of Technology, has attracted a great deal of attention, and a similar machine is being built in Great Britain by Prof. D. R. Hartree of Manchester. Dr. Bush has now, in collaboration with Dr. J. B. Wilbur, constructed another machine, the purpose of which is to give the solution of a number of simultaneous algebraic equations of the first degree. A larger model, containing nearly 1,000 pulleys and more than 500 feet of steel tape, has been designed, but is not yet constructed. This will deal with ten variables connected by ten equations, and will be of great use in the solution of problems such as the determination of stresses in buildings and the adjustment of triangular networks in surveying, which, treated by ordinary methods, require long and tedious calculations.

Toads Save Sugar Crop

Biological control seldom extends to the importation of Amphibia, but great success has followed the establishment of the large toad *Bufo marinus* in Puerto Rico. From two lots of this species brought to Puerto Rico from Barbadoes and Jamaica, millions of descendants have sprung, and the food of this host has consisted largely of the May-beetle (Science Service, Washington, D.C.). The sugar crop, which is the staple product of the island, was threatened by great numbers of the 'white-grubs' of May-beetles, which swarmed everywhere in the soil, devouring the roots of the cane and of other plants as well, so that the planters were reduced to picking the grubs by hand. The introduction of the toad has reduced the May-beetles to scarcity, and the Porto Rican sugar crop has been freed from its worst enemy.

The 200-inch Mirror

ACCORDING to a message from its New York correspondent which appeared in the *Times* of December

4, the 200-inch mirror has been cast, this time successfully, so far as can be judged, at the Corning glass works. It will be remembered that the pouring which took place last March was unsuccessful, as part of the mould became detached and floated to the top of the molten glass. The recent pouring has been uneventful, and the mirror, which weighs twenty tons, and is made of borosilicate glass, has been set aside to anneal. It will be ten months before the mirror has cooled sufficiently to be inspected critically. Mount Palomar, in southern California, has been selected for the site of the 200-inch telescope when completed.

Unity History School, 1935

DURING Easter of next year (April 13–27) a Unity History School will be held at Rome under the direction of Mr. F. S. Marvin, in co-operation with the Institute of the History of Science, Rome. The subject will be "Science in the Modern World" and it will be dealt with from various aspects by speakers of authority in their different spheres, some from England and some arranged by the heads of the Institute of the History of Science—Profs. Enriques and Santillana. The speakers from England will include Mr. F. S. Marvin on "Science and the Unity of Mankind", Dr. C. H. Desch on "Science and the Amelioration of Life", and Prof. H. Dingle on "Modern Developments of the Physical Conceptions of the Universe". Further particulars may be obtained from the Hon. Sec., Mrs. K. E. Innes, 29 High Oaks Road, Welwyn Garden City, Herts.

Announcements

WE have received the following cable from Brisbane dated December 3: "My experiments have proved human enamel permeable to carbonic acid, product of fermentation sugars, hence caries. This explains why prevention caries secured by citrates. Livingston, University, Brisbane."

THE Gold Medal for 1934 of the Royal Agricultural Society of England has been awarded to Sir Arnold Theiler, formerly director of veterinary research in South Africa, for his work in veterinary pathology, which over a period of more than thirty years "has been of tremendous benefit to mankind in the Union of South Africa and to the Empire as a whole".

PROF. CARL J. WIMAN, professor of palæontology in the University of Uppsala, and Prof. František Slavik, professor of mineralogy in the University of Prague, have been elected foreign members of the Geological Society of London. Prof. Pentti E. Eskala, professor of geology and mineralogy in the University of Helsingfors, Prof. Giuseppe Stefanini of Pisa and Prof. Frédéric Roman, professor of geology in the University of Lyons, have been elected foreign correspondents.

IT is announced in *Science* that the Perkin Medal for 1935 has been awarded by the American Section of the Society of Chemical Industry to Dr. George O. Curme, Jr., vice-president of the Carbide and Carbon Chemicals Corporation, for his "distinguished research in the field of organic synthesis which has led to the founding of a new industry".

THE fourth award of the Joseph Leidy Medal of the Academy of Natural Sciences of Philadelphia "for the best publication, exploration, discovery or research in the natural sciences" has been made to Gerrit Smith Miller, Jr., curator of mammals in the United States National Museum at Washington. Mr. Miller was selected for his extensive and fundamental studies on the structure, classification, distribution and evolution of the Mammalia, particularly of the Chiroptera (bats), the mammal faunas of North America, western Europe, south-eastern Asia and the East Indies, and the Pleistocene and sub-fossil West Indian members of the group, as well as his comprehensive classification of the voles and lemmings of the entire world.

THE Adolf Fick prize, which consists of 1,000 marks with a silver portrait medal of the physiologist Adolf Fick (1829–1901), was founded by his sons in 1929 in commemoration of the centenary of his birth. It is awarded to any member of a German-speaking country for the most important publication on a physiological subject during the last five years, with the proviso that "the competitor has not shown any anti-German activity or committed any un-German action". The prize has recently been awarded to Hans Spemann, of Freiburg im Breisgau, by the Physico-Medical Society of Würzburg, before which he delivered an address on November 16 on experimental investigations on a theory of development.

MR. J. R. MOFFATT has been appointed farm manager at the Rothamsted Experimental Station in succession to the late Mr. H. G. Miller. Mr. Moffatt is a native of Cheshire and received his education at Beckenham County School and the Wye Agricultural College. He graduated B.Sc. in agriculture of the London University, and in addition gained the National Diploma in Agriculture and the Wye College Diploma. For the past two years he had been working on the Rothamsted farm, first as recorder and assistant manager, then as temporary manager during the illness of Mr. Miller.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A technical adviser and inspector in connexion with optical instruments—The Director-General, India Store Department, Belvedere Road, London, S.E.1 (Dec. 12). An assistant lecturer in chemistry at the Robert Gordon's Technical College, Aberdeen—The Secretary (Dec. 15). A deputy director of civil aviation in India.—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Dec. 21). A William Gibbins fellow in metallurgy at the University of Birmingham—The Secretary (Dec. 31). A University professor of physiology at St. Mary's Hospital Medical School—The Academic Registrar, University of London, S.W.7 (Feb. 15).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 901.]

Elimination of Water from the Human Body

SHORTLY after the first application of radioactive isotopes as indicators, the late H. J. G. Moseley and one of the present writers discussed the prospect opened by the introduction of this method, when indulging in a cup of tea at the Manchester Physics Laboratory. The latter then expressed the wish that an indicator might be found which would allow one to determine the fate of the individual water molecules contained in the cup of tea consumed. Even a man of the vision and outlook of the late H. J. G. Moseley considered this hope to be a highly Utopian one.

The recent work of Urey and his collaborators brought, however, the above-mentioned wish within the range of realisation. Although diplogen and hydrogen, unlike the atoms of radioactive isotopes, are not practically inseparable by chemical means, yet if we add to a cup of tea a slight amount of heavy water and then find, for example, one per cent of the latter in the water which has left the body, we can assume that about one per cent of the 'normal' water molecules taken in with the cup of tea has shared the same fate.

TABLE 1.

Density of water prepared from urine after the intake of diluted heavy water.

Time elapsed since the intake of water started in hours	Urine (volume passed in c.c.)	Density difference between water prepared from urine and 'normal' (distilled) water
0·5	130	6×10^{-6}
0·8	190	10
1	230	15
1·2	210	21
1·5	230	23
1·8	290	25
2	160	21
2·5	80	20
4	120	18
8	130	20
10	290	18
17	320	20
23	140	19
24·5	210	18
42	820	19
67	1120	17
92	2100	17
244	—	10
340	—	8

That heavy water present in high dilution in the organism behaves like light water is borne out by the fact that the heavy water content of urine and other excreta is the same as that of ordinary tap water, within a limit of 1 : 100,000 as found by us and other experimenters[1]. If we slightly increase the heavy water content of the normal water we can assume that, with an accuracy sufficient for our purposes, the heavy water will show the same behaviour as the normal one. As a further argument in favour of this view, we may quote the results obtained when investigating the behaviour of highly diluted heavy water in the body of fishes[2].

Our first step was to investigate if water prepared from urine has the same density as the tap water drunk. The result was within $1 : 10^6$ in the affirmative. The preparation of water from urine was carried out by combined adsorption and distillation processes. 55 samples of urine and other excreta were investigated and more than 1000 distillation processes carried out. One of us took then in one experiment 150 c.c. and in another 250 c.c. water containing 0·46 per cent heavy water showing a density difference against normal water of 480×10^{-6}. As the increase in density of the urine obtained after the intake of these quantities was only a few units in a million, an experiment was made in which 2000 c.c. were taken. The increase in the density of the water obtained was then up to $25 : 10^6$. Some of the results are seen from Table 1.

From the above figures it follows that, after half an hour from the beginning of the intake of water, some of the water drunk is found in the urine, though only 0·2 per cent of the amount taken. The bulk of the water leaves the body at a slow rate and it takes 9 ± 1 days before half of the water taken has left the body.

We controlled the water balance during the experiments and found (in hot summer weather) that on an average 60 per cent of the water lost left the body through transpiration and evaporation. In the possession of these data, and as we find that the density of urine water and transpiration water is the same within the limits of our accuracy relevant for these considerations ($\pm$ 5 per cent of the density excess), we can calculate the time which elapses before half of the water taken left the body by an independent method. The result works out again as 9 ± 1 days. By dividing the last figure by ln 2 we get for the average time a water molecule spends in the body $13 \pm 1{\cdot}5$ days. To explain this comparatively long time, we have to assume that most of the water taken becomes completely mixed with the water content of the body. This assumption can be tested by calculating the water content of the body of the experimenter from the amount of diluted heavy water taken and the density of the water prepared from urine any day except the first one. We arrive at a water content of 43 ± 3 litres, namely, 63 ± 4 per cent in fair accordance with known data.

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[1] H. J. Emeléus, F. W. James, A. King, T. G. Pearson, R. H. Purcell and H. V. A. Briscoe, *J. Chem. Soc.*, August, p. 1207, 1934.
[2] G. v. Hevesy and E. Hofer, *Hoppe-Seylers Z.*, **225**, 28; 1934. cf. also G. N. Lewis, *Science*, **79**, 151; 1934. H. Erlenmeyer and H. Gärtner, *Helvet. chim. Acta*, **17**, 334; 1934.

Liberation of Neutrons from Beryllium by X-Rays: Radioactivity Induced by Means of Electron Tubes

IT has been recently reported[1] that neutrons are liberated from beryllium by γ-rays of radium and that these are able to induce radioactivity in iodine. Following up this work, we have attempted to liberate neutrons from beryllium by means of hard X-rays, produced by high-voltage electron tubes. An electron tube, which could conveniently be operated by a high-voltage impulse generator at several million volts[2], is at present in use in the High Tension Laboratory of the A.E.G. in Berlin, and has served in the present experiment for the production of X-rays.

X-rays from a tungsten anticathode generated at a voltage above $1{\cdot}5 \times 10^6$ v. were allowed to fall on beryllium. An organic bromine compound (bromoform) was exposed to the radiation of the beryllium and this compound was then sent by air from Berlin to London. Here, at St. Bartholomew's Hospital, after an isotopic separation[3] of the radio-bromine from the ordinary bromine, a weak activity decaying with the six-hour period of radio-bromine was observed.

Afterwards, at a higher voltage, but still below 2×10^6 v., very much stronger activities were induced in bromine and were observed both in Berlin and London. Strong activities were observed in Berlin both in bromine and iodine (30 minutes half-life period) in co-operation with K. Philipp and O. Erbacher of the Kaiser Wilhelm Institute for Chemistry, the activity and its decay being easily measured by means of an electroscope. Recently, Fermi, Amaldi, Pontecorvo, Rasetti and Segrè discovered[4] that by surrounding the irradiated material with substances containing hydrogen the efficiency of activation of certain elements by neutron bombardment is greatly increased. Use was made of this effect in these experiments.

A very sharp increase of the induced activity with increasing voltage is to be expected if there is a more or less sharply defined upper limit of the wave-length at which the liberation of neutrons from beryllium begins. If there is such a critical wave-length, and if the voltage applied to the tube only slightly exceeds the corresponding critical voltage, a small fraction only of the total X-ray energy will be present in the form of radiation of sufficiently short wave-length; this fraction will then increase sharply with the excess voltage.

We wish to thank Prof. L. Meitner for her kind assistance in the Berlin experiments.

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London, E.C.1. LEO SZILARD.
Nov. 26. F. L. HOPWOOD.

[1] Szilard and Chalmers, NATURE, 134 .494, Sept. 29, 1934.
[2] Brasch and Lange, *Z. Phy.*, 70, H. 1/2.
[3] Szilard and Chalmers, NATURE, 134, 462, Sept. 22, 1934.
[4] Fermi, Amaldi, Pontecorvo, Rasetti and Segrè, *La Ricerca Scientifica*, 2, Nos. 7–8.

Nature of Atmospherics

THE purpose of this note is to clear up some confusion which appears to exist concerning the average duration of atmospherics. Appleton, Watson Watt and Herd[1], and also Cairns[2] give times of the order of milliseconds for the duration of the atmospherics which they observed. On the other hand, observations which have been made in Australia using an ordinary tuned receiving set, and recording the motion of the string of an Einthoven galvanometer on moving photographic paper, have given durations ranging, in most cases, from 0·2 sec. to 0·5 sec., and occasionally longer. This is also the order of magnitude of duration which is deduced from listening to an ordinary broadcast receiver.

The difficulty is resolved if one examines the wave-form of the atmospheric with a cathode ray oscillograph provided with a time-base of considerably slower period (say 0·1 sec.) than was used by the above-mentioned investigators. Experiments made at Laverton (near Melbourne) and Toowoomba (south-east Queensland), using an aperiodic receiver of somewhat similar type to that used by these investigators indicated that the 'atmospheric' really consists of a number of discrete pulses, separated by clear intervals. The sizes and separations of the component pulses vary in an irregular manner, this giving rise to the rough noise produced in a broadcast receiver.

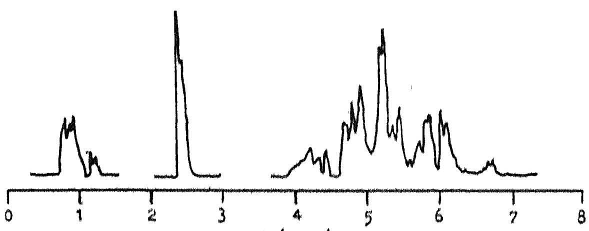

FIG. 1. Typical atmospherics. Einthoven galvanometer records, using tuned circuit of decrement about 10 sec.$^{-1}$.

This result is confirmed by the photographs of lightning flashes (the source of atmospherics) taken by Schonland and Collens[3], Boys[4], Halliday[5] and Walther[6], with moving lens cameras. Schonland and Collens, for example, obtained photographs of flashes with a camera in which a pair of lenses revolved at about 25 rev. per sec., and simultaneously with an ordinary camera. The moving-lens camera usually showed several flashes where the fixed lens showed only one (sometimes branched). The actual temporal separation cannot be obtained from the photographs since, as the authors point out, several revolutions of the lens system probably occurred between the flashes. The photographs show a relatively small number of constituent flashes (not more than ten), whereas our observations showed up to fifty constituent pulses. It is possible that a multitude of small flashes occur within the cloud, which the photographs do not reveal. In this connexion it may be noted that the first in the succession of pulses is by no means necessarily the largest. (This has been noted also in observations with the cathode ray direction-finder.)

The observations of Appleton, Watson Watt and Herd were evidently made with such rapid time-bases that only one of the constituent pulses was

(*Continued on p.* 897.)

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Reviews

Sir Ambrose Fleming's Reminiscences

Memories of a Scientific Life. By Sir Ambrose Fleming. Pp. xii+244+3 plates. (London and Edinburgh: Marshall, Morgan and Scott, Ltd., 1934.) 5*s*.

WE think that everyone will derive pleasure from reading the reminiscences of Sir Ambrose Fleming. Beginning with an adventure in the nursery when he was less than three years old, it is interesting to read the events which left a strong impression on the mind of the budding man of science. When he was nine he saw Donati's comet (1858)—with its tail stretching a quarter of the way across the sky. Although secretly alarmed he was greatly interested, and if a suitable opportunity had occurred he might have become an astronomer. A few years later we find him sailing a large model yacht, which he had carved out and rigged himself, on the Hampstead ponds, and he was taken to see 'Pepper's ghost' at the Regent Street Polytechnic. 'Dissolving views' were shown with a pair of oxyhydrogen light magic lanterns and he remembers the thrilling pictures of the Indian Sepoy mutiny. Lectures on chemistry were also given, and one of his favourite books was "The Play-Book of Science" by Prof. Pepper. At sixteen years of age he entered University College, and on completing his course was placed in the first division in the B.Sc. examination. His father's friend, afterwards Sir Edward Frankland, helped him to get a science mastership at Rossall School, where he proved himself a most capable teacher. But he hankered after research work, and so we find him a year and a half later studying under Dr. Frankland in the Science Schools at South Kensington. One of his fellow students was Sir Oliver Lodge, who in a 'foreword' to this book points out the many similarities in their two careers.

Fleming then became a research assistant to Dr. Frankland, and one of his colleagues was R. Meldola, the great chemist, and he met there Prof. Guthrie, the founder of the Physical Society. At the first meeting of this Society (March 21, 1874), Fleming had the honour of reading the first paper. He was then appointed to a science mastership on the military side of Cheltenham College and for three years proved an excellent teacher who could interest the boys and yet maintain discipline, but although receiving £400 a year and with a good prospect of a house mastership, he thought it a 'blind alley' occupation and in 1877, at the age of twenty-seven, went to Cambridge to study under Clerk Maxwell. Although his classical knowledge had become rusty he passed the 'Little-go' and entered St. John's College. Fleming says that as a teacher Maxwell was difficult to follow and his classes were small—on one occasion Fleming was the only student. But he says that everything Maxwell did or said bore the stamp of genius. In 1880 Fleming took a first class in the Natural Science Tripos, his subjects being chemistry and physics. He next did research work at the Cavendish Laboratory and began to improve the methods of making electrical measurements, a branch of the subject on which he did much excellent work later. He next became demonstrator in mechanism at Cambridge under Prof. James Stuart, the predecessor of Sir Alfred Ewing.

In 1881 Fleming went to Nottingham University College as the first professor of mathematics and physics. From 1885 until 1926 he was a professor in University College, London, and did much valuable work in research and as a consulting engineer. At the Deptford Power Station his researches led to great improvements; the results were afterwards communicated to the Institution of Electrical Engineers. In 1885 he read a paper to this Institution advocating the establishment of a National Laboratory for testing and certifying the accuracy of electrical instruments. His researches in conjunction with Sir James Dewar on the properties of matter at low temperatures led to very interesting and novel results.

As a teacher Fleming stands in the front rank; he has a wonderful knack of making things clear and of imparting his knowledge very rapidly. When the writer first heard him, many years ago, give a lecture, he was strongly reminded of the lecturing method used by Dr. E. J. Routh, the famous Cambridge mathematical coach. Another characteristic in his experimental lectures was the kind way in which he co-operated with his assistants to their mutual advantage.

As Fleming has written nearly a hundred

important scientific papers and also twenty books, some of which have gone through several editions, it is impossible to discuss them here. He was the first to explain the importance of the rectifying action in the devices commonly used in the early days of radio telegraphy, namely, the crystal detector, the electrolytic detector and the magnetic detector. His explanations enabled one to picture the actions taking place, and the phenomena ceased to be mysterious. The Wehnelt tube had rectified current, but no one thought of utilising this property for radio telegraphy. Fleming's great discovery was that, in order to obtain a receiving action, it was only necessary to rectify the high frequency alternations. The Fleming valve, which is a two element rectifier, was no more sensitive than a good crystal detector, but it had the inestimable property of permanence of adjustment. In this volume Fleming tells the story of his help in the arrangements made by means of which R. N. Vyvyan and others sent the first message across the Atlantic.

In conclusion, Fleming gives a sketch of many enjoyable holidays he has spent abroad and tells vividly what a relief they were after lecture-rooms, laboratories and libraries. He revels in the beauties of Nature as shown in mountain, sea, lake and forest. He has climbed Mont Blanc and several lofty peaks in Switzerland. He gives good advice also. "In all Alpine ascents the weather is the uncertain factor, and it is never wise to attempt a high mountain except in perfect weather." We hope that he will write a further book of memories.

A. R.

The Autobiography of H. G. Wells

Experiment in Autobiography: Discoveries and Conclusions of a Very Ordinary Brain (since 1866). By H. G. Wells. Vol. 2. Pp. viii+417–840+11 plates. (London: Victor Gollancz, Ltd., and The Cresset Press, Ltd., 1934.) 10*s.* 6*d.* net.

THIS is an attempt on the part of the author to trace the development of his own mind, and, as he sees them now, the social forces and personal characteristics conditioning the changes that ensued. Thus we are presented with a slab of social space-time, and the world-line H. G. Wells has traced out in it. We see the ineffectual draper's assistant blossoming forth as a serious-minded science student, the student as a competent journalist, and the journalist, through external stress and struggle and internal strife, into a literary innovator and a social force. The drudgery and degradation of 'living in', sow the seeds of rebellion and social discontent. A fleeting and not too academically successful passage through the Royal College of Science provides the quickening. The chrysalis unfolds and the grown Wells emerges, the literary and moral iconoclast, the pioneer of science for the common man, the dreamer of a World State. The autobiography is like a swelling orchestra; as each new instrument adds its part it gradually assumes the appearance of a fugue working up to its climax—the Modern Utopia, the New Republic, the League of Free Nations, the World State.

For two generations the author has striven with consummate journalistic skill and tireless energy, by educating his public, to get them to appreciate his theme and to desire its realisation. In particular he has succeeded: in general he has failed.

It began as a struggle against the prudery, inhibitions, and falsehoods of the Victorian era, a fight to the success of which he contributed more than any living man. Few of us who read our modern novels and listen to our problem plays realise how much we owe to the author of "Ann Veronica". When the storm of abuse aroused by that novel had subsided, and the social ostracism meted out to the author had passed, it was evident that a long-awaited release had occurred; a new mood had entered into literature and with it into social life.

This, however, was one only of the fronts on which Wells waged his war. The inspiration of T. H. Huxley at the Royal College of Science had aroused him to the significance of the theory of evolution for mankind, and the possibilities for the future that lay in the fullest use of the findings of science. To him it meant a levelling of political frontiers and a new scale of life. The ideas can be seen germinating in his early scientific stories, and blossoming forth later in the scientific passages in his socially propagandist books. Finally it takes concrete shape in his "Modern Utopia", that marvellous *tour de force* the "Outline of History", his "Work, Wealth and Happiness of Mankind", his "Science of Life", "The Shape of Things to Come", "After Democracy" and numerous other volumes. It is an amazing performance, this steady and rapid output showing the gradual experimental groping towards precision in an idea at first faintly perceived and finally forcing itself more and more into definition with the logic of events.

In particular, Wells succeeded. He jerked the youth of last generation out of their complacent acceptance of established tradition in politics, morals and religion. In letters he smashed the classical tradition that science and literature are necessarily inimical. To the man in the street he brought an understanding of his history, and of the scientific make-up of himself and his environment. In all this, and more, he succeeded, and he

succeeded because he was supersensitive to the mood of his times.

For the 'seventies and 'eighties were a critical phase in the development of Great Britain. Industries had flourished steadily as England poured her manufactured goods into the Colonies and Dependencies ; Free Trade and Liberalism had provided the theoretical justification for our entry into all and every market of the world. They were principles that seemed to accord simultaneously with enlightenment and self-interest. Germany emerging now as a new united State from the Franco-Prussian war consciously threw herself into the industrial struggle and turned to organise scientific knowledge and scientific research to assist her. In the face of this, Britain turned in the same direction, but not before a temporary stagnation had given warning of troubles ahead. Science was in the air, and the windows of schools and colleges were slowly being prised open to allow the new enlightenment and the new knowledge to penetrate. Trade schools and evening classes, colleges of science and scientific laboratories, began to spring up, and for those who, like the young Wells, had noses to sniff, a new and stimulating atmosphere began to make itself felt. Huxley spread the gospel of Darwinism and fought the Bishops ; the Trade Union movement strengthened, became militant and neo-Marxist, seeking its own special representation in Parliament as a special working class movement ; and Wells and his associated intellectuals swept into the Fabian Society to impregnate this movement on the political side with the policy of gradualness and planning for their new social order. The names that stand out boldly in this period are Wells, the upstart scientific groper and visionary ; Shaw, the sharp incisive critic and mental gymnast ; and Sidney and Beatrice Webb, the embodiment of the British Museum. These were the currents that swept Wells on his way, and through which he swam on his distinctive route.

What of the outcome of it all ? What of the ideal to which Wells devoted so much of his life ? In the last few pages of this extraordinary story he sums up his final conclusion :

"The truth remains that to-day nothing stands in the way to the attainment of universal freedom and abundance but mental tangles, egocentric preoccupations, obsessions, misconceived phrases and bad habits of thought, subconscious fears and dreads and plain dishonesty in people's minds—and especially in the minds of those in key positions." And then apropos of the latter : "I can talk to them and unsettle them but I cannot compel their brains to see."

Now of one thing Wells may be quite certain : most of these individuals in key positions have brains. Then why, he must ask himself, do they not see ? Perhaps after all it is not simply intellectual assent only that is needed, but also emotional harmony. To desire a new social order implies a valuation, and a valuation of a type that does not come into scientific or mathematical propositions. Why should he expect that the people in key positions would want the kind of world that Wells himself desires ? They may see that in the long run it is inevitable, but why should he expect them to raise a finger to shorten the run ? The answer is not to be found in the intellectual sphere. It must be expressed in terms of the physical circumstances that arouse the desire to which he is appealing. He is in fact addressing an intellectual and emotional argument to a group of individuals from whom he need not expect to receive an emotional response.

The same weakness in the methodology of Wells's propaganda can be seen in another way. After almost half a century of energetic striving for his ideal, is his plaint not rather like the old statement that, if only everyone had goodwill, everything would be for the best ? Surely the first question to ask is what are the material conditions requisite for goodwill ? What are the material conditions for eliminating the egocentric preoccupations ? Is it within the power of Mr. Wells to produce these conditions, or is it the case that those who control the conditions are also those who possess the stubborn traits to which he objects ? If this is so, is it not evident that Wells has not faced his problem squarely until he has faced the problem of how to acquire power ?

The lack of a clear analysis of this issue shows itself over and over again, but particularly when he bitterly laments his failure to get Stalin to see that Russia and the United States are in fact treading the same path. The suggestion (apart from the trivial interpretation that we are everywhere treading the same path) is fantastic. The emotional motifs and the whole working structure of the two countries are poles asunder. The dislike of Roosevelt for the Russian system is probably equalled only by the repugnance of Stalin for the American, and in any objective handling of propaganda for a World State these are facts to reckon with. In social science, unlike physical science, the changing likes and dislikes of the human material play a significant rôle.

He who desires to forecast the future behaviour of social groups and to play his part in that development, as Wells does, must evolve a science of social dynamics. He has to study society as a material phenomenon, and deduce its laws of change. He has at the same time to recognise that these laws are brought into existence by human

beings in the teeth of opposition by others, each striving to carry out his desires. Only those desires that are consistent with material possibilities are therefore capable of reaching fruition. To bring them into being, either those who have the desires that can be realised must acquire power, or those who possess the power must acquire the realisable desires. Wells's complaint concerning the obtuseness of those in key positions is in effect an admission that those who have the power cannot acquire the desire. One can only conclude that either he must become a full-fledged active revolutionary or he is seeking to bring the wrong type of World State into being.

It is for these reasons, a false methodology in his propaganda or the pursuit of a false ideal, that the reviewer holds that while Wells has succeeded in particular he has failed in general. One of the particulars, however, in which he has undoubtedly succeeded is in the creation of a new form to suit the content of autobiography. Throughout the whole of the work, in striking contrast to the babbling inconsequences and fatuous anecdotes of social nonentities invariably found in the compendious volumes that pass for autobiography, he has examined his own developing mind with relentless objectivity. With this and the preceding volume he has smashed a staid and formal tradition and raised autobiography to a new level.

H. Levy.

Annals of the Arctic

Northern Conquest: the Story of Arctic Exploration from Earliest Times to the Present. By Jeannette Mirsky. Pp. xx + 386 + 16 plates. (London: Hamish Hamilton, Ltd., 1934.) 15*s.* net.

The Conquest of the North Pole: Recent Arctic Exploration. By J. Gordon Hayes. Pp. 317 + 16 plates. (London: Thornton Butterworth, Ltd., 1934.) 18*s.* net.

THE word "Conquest" with regard either to exploration or research seems to postulate an antagonism between man and Nature, and it is perhaps a mistake to allow such an 'evil dream' to colour one's view. Although the pioneers of polar travel had to meet great difficulties and to undergo hardships which it required heroism to face, the knowledge they acquired should have taught those who followed that success awaited the men who took advantage of existing conditions rather than those who fought against forces they could not control. The belief that a fighting rather than a conciliatory spirit best suited an explorer is no longer justified; but writers and publishers of works on exploration apparently find the warlike phrase agreeable to public taste.

Even those who deprecate fancy titles for serious works must allow that both the books named above are serious contributions to the history of exploration. They are sufficiently non-technical to appeal to the general reader, but careful enough to serve the student for permanent reference, especially as they have admirably full indexes. Their value is enhanced also by the supervision during compilation of experienced arctic travellers who were themselves men of science. The critical adviser of the English author prefers to remain anonymous, that of the American reveals himself as Dr. V. Stefansson, who contributes an introduction to Miss Mirsky's book. Mr. Gordon Hayes writes his own introduction, and both lay stress on the importance of impartiality and open-mindedness on the part of the writers of history. Both deplore the shortcomings in this respect of earlier works of similar scope. The English writer commends General Greely's "Polar Regions in the Twentieth Century", but only as "a species of intellectual pemmican", and after referring slightingly to certain unnamed works of popular travel he comes to the satisfactory conclusion that "uncritical works are now intellectually obsolete".

Dr. Stefansson's introduction makes something like a berserk attack on Sir Clements Markham's "Lands of Silence", many of the flaws in which might be put down to the failings of extreme old age. The author of "The Friendly Arctic", however, while insisting on the duty of taking up an unprejudiced point of view, naïvely expresses pleasure at the gradual approach of Miss Mirsky to his own set opinions. This hint at a comedy of prejudices is by the way. My main purpose is to welcome two very fine books, neither of them perfect it is true, but each in its own way deserving of warm commendation to the student and to the lover of adventure.

Miss Mirsky traverses 22½ centuries, Mr. Hayes only the first third of the present century, so the scales necessarily differ; but as the long-period record has a sliding scale growing larger as the date approaches the present, there is overlap enough to afford interesting comparisons. Divergent views are expressed on controversial matters. Both handle the Peary-Cook controversy with wisdom and restraint. Mr. Hayes obviously controls his feelings in showing quietly the impossibility of Peary's alleged long daily journeys to the Pole and back, and as obviously restrains his warm sympathy with Cook, whose amazing narrative he finds perfectly credible. Miss Mirsky, on the other hand, states the pros and cons for each explorer with an obvious, though not an obtrusive, leaning towards Peary and a distinct aversion from Cook. Again Miss Mirsky is, of course, very friendly in her judgment of Stefansson's revolu-

tionary method of 'living off the country', for it was in his unique Arctic library that she spent three years in compiling her record, while Mr. Hayes brings the whole force of his critical powers to show that Stefansson's methods are unsuited for the use of men of less Herculean mould. But both writers set out the facts fairly, and no one need be misled by the flickering of personal predilections which light up a depressing subject.

(1) "Northern Conquest" is a brilliant book. To turn over its pages of history from the most distant ages is like turning one's eyes to the starry sky on a moonless frosty night. Against the Milky Way of early tradition the stars of great explorers shine out sharp and sparkling each in its appointed place, each of its proper magnitude. The author, of Russian race, trained by American education and using the English language as the natural medium of her thought, has achieved a detachment from prejudice and a wide sympathy with divergent methods and motives denied to most historical writers. By means of a series of appendices she clears the text of confusing repetitions and distracting footnotes. One appendix gives a full list of the leaders of the Franklin search parties and their ships with the dates and districts explored. Another a skeleton chronology of Arctic exploration—date, explorer, region visited—from Pytheas *c*. B.C. 330 to Wilkins in his unlucky submarine of A.D. 1932. A third appendix gives references to the main sources relied upon for the compilation of each chapter. By this means Miss Mirsky is able to deal in the text with the motives, the character and the achievements of each explorer in a well proportioned narrative, and she succeeds in preserving the atmosphere of the time and the place by discriminating quotation. This is how she touches an early wintering in Hudson Bay:

"In 1631 Captain James wintered unhappily and to little purpose in the extreme south eastern dip of the bay, and the account of his voyage is verily a 'book of lamentation and weeping and great mourning'. That same year Luke Foxe, the self-styled Northwest Foxe, explored the waters to the west and east of Southampton Island. He poked into Sir Thomas Roe's Welcome, mistook it for a bay, and then sailed a little way up Foxe Channel, pompously calling his turning-point 'North-West Foxe his Furthest'. A shrewd, gay man, he named a cape Wolstenholme's Ultimum Vale, for the reason 'that I do believe Sir John Wolstenholme will not lay out any more monies in search of this bay'. He was right."

"Northern Conquest" is certainly not intellectual pemmican; it rather resembles a tasty and nourishing Christmas pudding full of choice fruit, carefully stoned, and flavoured with the spirit of youth and the spice of humour. Now and then one comes on a hidden charm in the form of some quaint American locution.

(2) Mr. Gordon Hayes is well known as an enthusiastic student and an iconoclastic critic of Antarctic exploration and of some Arctic explorers. He has modelled his "Conquest of the North Pole" on the lines of his recent "Conquest of the South Pole". It is a detailed, critical and conscientious statement of all the Arctic expeditions since 1905. With his usual love of accuracy in detail he has secured the revision of the relative portions of his manuscript by many, if not most, of the explorers he deals with who are still alive. He excels in the precision with which he sets down the length of daily journeys, the nature and quality of the means of transport and the extent to which the purpose of each expedition was fulfilled. His book is not a transcript of published matter or a commentary on journeys familiar to most English readers of polar books, but includes the records of Russian and Scandinavian travellers whose work has not hitherto appeared in English. Mr. Hayes is an earnest worker, concentrating on essential facts, seldom led away in lighter mood from his stern critical scrutiny of the explorer with whom he is for the moment concerned. His method does not require fine language for its expression, and even if the wheels of his literary chariot sometimes seem to cry out for lubrication, they carry him straight to his goal.

The reader who goes through this book will be thoroughly posted in the work of Peary, Cook, Mylius-Erichsen, Mikkelsen, Rasmussen, the two Kochs, de Quervain, Vilkitski and the other Soviet polar investigators, Bernier, MacMillan, the North West Mounted Police on their dismounted Arctic patrols, Stefansson and his comrades on the ill-fated *Karluk*, Wegener, the Oxford and Cambridge University expeditions under Binney, Wordie, Watkins, and a host of others. Finally, the airmen Amundsen, Nobile, Ellsworth, Byrd and Wilkins have their turn. All had great adventures and most of them collected scientific data which have still to be worked up. Over all the author like Burns's Justice "high wields her balance and her rod" and there is little indeed in the way of shortcomings which escapes him. The eagle eye of his learning scarcely goes so far as to "seek Science in her coy abode" though he speaks very respectfully of her. He is strongly in sympathy with the new trend in exploration which is contemporaneous with, and has been effectively furthered by, the Scott Polar Research Institute at Cambridge. After pointing out the limitations of expeditions sent out under orders by Governments or learned societies, and of those in which a leader initiated and directed his own work, while depending on Press support for funds, he says:

"Both these methods, especially the former, now seem relatively unsuitable for Arctic exploration and a great change was made by Rasmussen and Stefansson . . . another new type of expedition was introduced on the founding of the Oxford and Cambridge Schools of Explorers. While not unadventurous, this type is academic in character, benevolently monarchical in government and desirous of avoiding heroics."

The work of Mr. Hayes in his detailed account of the recent expeditions is well-planned, sound and solid. A few slips in proof-reading leave some erroneous initials in the names on p. 305. The publishers and place of publication of the books cited on that and the following page might well have been given in order to facilitate reference.

I conclude with two morals which may be drawn from the records in both of the books under review: the supreme importance of careful note-taking and log-keeping by every member of an expedition; and the equal duty of every society which rewards success to insist on seeing and testing the original data before awarding its medal. HUGH ROBERT MILL.

Problems of Longevity and Eugenics

(1) *The Ancestry of the Long-Lived.* By Raymond Pearl and Ruth DeWitt Pearl. Pp. xiii+168. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1934.) 13*s*. 6*d*. net.

(2) *Human Sterilization To-day: a Survey of the Present Position.* By Cora B. S. Hodson. (The Forum Series, No. 19.) Pp. vii+56. (London: Watts and Co., 1934.) Cloth, 1*s*. net; paper, 7*d*. net.

(1) THE authors confess, with regret, that this book cannot be looked upon as easy reading, and they are probably right. On the other hand, they seem to be fully justified in saying that anyone who is really interested can follow the reasoning and understand the results. It is to be hoped that many people, other than specialists in the subject, will read it.

The results are, briefly, that your chances of living to more than ninety years of age are much greater if all your parents and grandparents lived to be more than seventy than if only some or none of them did. Yet your chances cannot be completely forecast on that basis since, in 13 per cent of the nonagenarians and centenarians studied, and in about 10 per cent of their parents, neither parent lived to be more than seventy. It is impossible to say to what extent that fact depends on failure to realise potential longevity because of environmental 'accidents' such as death in childbirth or from acute infections.

Further, the brothers and sisters of these nonagenarians and centenarians showed an average duration of life well above the standard expected mean duration at birth. The families were, on the average, larger than those of the series used for comparison, and the mortality, especially during infancy and childhood, much below the rates for the general population. This indicates that longevity is associated with a high general vitality, which is not an attribute only of one particular individual in a family, but of the family as a whole.

In this lies the chief practical interest of the study. For, although it is doubtful whether longevity in itself would be regarded, generally and without qualification, as a desirable characteristic, there can be no doubt that superior healthfulness of a whole family would be so regarded.

It is a relief that no attempt is made, at this stage, to analyse the data from the point of view of the mechanism of inheritance. In the present welter of eugenics, theoretical and practical, this study might be taken as a model of what is required as a foundation for rational judgments, and certainly the following quotation should be noted by all enthusiastic eugenists: ". . . the case of modern genetics and particularly human genetics is being seriously harmed by wildly uncritical extension of the gene theory, for which the observed evidence is either wholly lacking or is absurdly inadequate".

(2) Mrs. Hodson's book is in part a catalogue of information regarding the laws at present in existence relating to sterilisation, and, as such, it quite adequately fulfils its purpose. The information appears to be reliable, is concisely put down, and may be recommended to anyone desiring a rapid survey of the position.

On the other hand, in as far as the book offers, without any attempt to state the laws of heredity involved, to explain and justify the aims of the campaign for sterilisation, it is inadequate and may be misleading. The idea of eugenic sterilisation is based, we are told, on evolution, in the Darwinian sense of natural selection. But it is, in fact, based on the evidence, from actual human pedigrees, of Mendelian segregation of undesirable characteristics, which is a very different matter.

On the practical side there are two points, in particular, that require consideration. The first is the statement that preventive medicine "is actually promoting the increase of constitutional diseases" since, previously, "the tainted stock was kept down to very small numbers" by the ravages of (germ) disease. If this statement is to have any meaning, it must imply a higher death rate from acute infections amongst persons affected with these constitutional diseases than amongst

the non-affected. But is there any evidence that the bearers of the diseases in question are abnormally susceptible to infectious disease? If this were so to any significant degree, it would certainly be apparent, even without such infections as cholera and smallpox, in a high death rate, and it is unlikely that the proportion of affected persons in the general population would be increasing, as is claimed.

The second point is the clearly stated attitude to inherited but curable disease. "It is as much against philanthropic ideals as against sound sense to cure the results of a bad constitution" if reproduction is allowed. Assuming that this book represents a certain class of opinion, there appears here to be serious ground for debate. Apart from the probability that the same or other defects would arise *de novo*, it seems reasonable to think that the problem of such diseases must be decided in human society, which is not merely a herd, on considerations other than that of the disease itself. In the evident absence of ideal individuals who can be guaranteed to breed ideal progeny indefinitely, there is as much to be said, on the present evidence, for using the triumphs of medical research to preserve the germ plasm we have, as for using them as an excuse for its destruction.

The Eternal Village

Hooton Pagnell: the Agricultural Evolution of a Yorkshire Village. By Dr. Arthur G. Ruston and Denis Witney. Pp. viii+459+12 plates. (London: Edward Arnold and Co., 1934.) 25*s.* net.

A SURPRISING number of English towns and villages bear Saxon names, and it is remarkable how little the expanding population of the eighteenth and nineteenth centuries affected the number of settlements: old villages grew into towns, and adjacent villages gradually touched each other and became large cities, but there were not the new settlements that one sees in America. This persistence of the English village is one of its characteristic features, and in recent years there have been numbers of historical studies tracing particular villages back to their earliest times.

The village dealt with in the present volume, Hooton Pagnell in Yorkshire, has a special interest to the agriculturist because it was the residence in the early part of the fourteenth century of Sir Geoffrey Loutrell, who arranged for the making of the wonderful Psalter that bears his name and that gives us better pictures of agricultural operations than any other document of its time. The implements are so well shown that they could be reconstructed by a village smith without difficulty; the men and animals are drawn with rare skill and vigour, and are obviously taken from life. Dr. Ruston and Mr. Witney have followed the history of the village from Domesday Book, where it is called "Hotone", right up to the present time, searching every old document they could find with the painstaking conscientious labour associated with all Dr. Ruston's work. Even apart from its intrinsic interest, the book is useful as showing the range and extent of sources of information about the village life of the past; while the long quotations from the various documents serve to show the kind of use to which they may be put.

There have been no revolutions and no wars to speak of in the British countryside, and consequently the old records stored in church and manor house still survive in many places, furnishing material of considerable interest to present-day economists, geographers and agriculturists. In the English countryside, more perhaps than anywhere else in the world, the key to the present lies in the past: the things we now see have their roots deep down in the village history, and no one can understand the present position without a knowledge of how it came about. If, as sometimes happens with would-be social reformers, the story is quite unknown, or worse still, if it has been warped and twisted to suit a political theory, the vision will be wrong and the suggested reform is foredoomed to failure; only if the story is apprehended without prejudice and with a single eye to truth can any good emerge.

This book should be studied by all students of agricultural history, whether their interest be technical or social. It is well illustrated with maps showing the enclosures and the changes at the various times which have finally resulted in the village as it now stands. After perusing this book, the student will understand how it comes about that problems of tithe, of tenure and of tenant right, are so complex. E. J. RUSSELL.

An Unorthodox Chemistry

An Introduction to Chemistry. By Prof. Frank B. Kenrick. Pp. viii+434. (Toronto: University of Toronto Press, 1933.) 3 dollars.

PROF. KENRICK disarms criticism of this remarkable book by his statement in the preface that it "will not be found to be a 'teachable' book", but immediately throws down the gauntlet by continuing: "a teachable book must be a learnable book, and that is a most dangerous educational weapon". Such provocation in the preface whets our curiosity as to the text, but before we reach the latter we are 'brought up short' again by the table of contents. Chap. i begins with the manufacture of salt, and, after a

chapter on 'composition', two chapters are devoted to the refining of crude sugar and various chemical phenomena that the process involves. Chap. xii is entitled "Wood", chap. xiii "The Mass Law, Esterification, Synthesis of Ammonia, Dissociation, Electrolytes", chap. xiv "Air" and chap. xv "Rocks". We are led to murmur, like Alice, "Curiouser and curiouser", and to turn with now thoroughly stimulated eagerness to the body of the book. After the shocks we have already experienced, it is no surprise to find that Prof. Kenrick has certainly elaborated a unique method of approach to the study of chemistry. His first fifty pages are, in the main, devoted to a consideration of what chemists mean by the 'composition' of a substance ; in the end, after what seems to be a needlessly involved and verbose discussion, he arrives at the merely commonplace conclusion that the "composition of a material states a set of substances and their proportions which could be changed quantitatively into the material on the assumption that any actual transformation can be reversed".

Prof. Kenrick's treatment of further conceptions is on similar lines, his anxiety to frame definitions in strict accordance with fact leading him to disquisitions that must inevitably befog even the most earnest and conscientious of his readers. Thus the idea of a 'pure substance', which does not normally present any great difficulty to a student, is scarcely made clearer by a definition which describes a pure substance as one that "is not an intermediate member of any continuous series of non-mixtures". The explanation of symbols, formulæ and equations is equally long-winded and confusing, and is also inaccurate inasmuch as, for example, "H" does not stand for "1·008 of hydrogen" but for one atom of hydrogen—a very different thing.

It is, however, unnecessary to describe any further details of the book, except to remark that when Prof. Kenrick says (p. 352) that "equations such as . . . $CaCO_3 + 2HCl = CaCl_2 + CO_2$ seldom state the facts accurately", we find ourselves in complete agreement. No one would deny that the common methods of teaching chemistry are far from perfect, or that students frequently have far too hazy an idea of the precise meanings of terms that trip lightly from their tongues. In so far as Prof. Kenrick has realised this, and has tried to improve matters, he deserves commendation. But we fear that his book will do little to clarify confusion or to correct looseness of thought, and our sympathies are with the "Reverend professor of medieval history", who "read critically and patiently every sentence" of the book, but protested that he did not understand a word of it.

E. J. HOLMYARD.

The Structure of Solids

The Chemistry of Solids. By Cecil H. Desch. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 13.) Pp. ix + 213. (Ithaca, Ill.: Cornell University Press; London: Oxford University Press, 1934.) 11s. 6d. net.

TWENTY-FIVE years ago, the title of Dr. Desch's book might have been challenged as a contradiction in terms by those who maintained that in the solid state chemical change did not take place. Even to-day, there will be found many to argue that his subject matter is really physics—thus starting a profitless discussion, since the boundary-lines dividing the sciences are as arbitrary as any political frontier. But the fact is that Dr. Desch deals with many things which—being equally important to physicist and chemist—are usually admitted to the curriculum of neither. He has indeed made his volume all the more valuable to chemists by surveying researches originally published in physical, crystallographic or metallurgical journals, which they rarely find time to study. These he discusses in an interesting manner—not unsuited for armchair reading. The treatment is in the main elementary, calling for little previous knowledge ; but, although the complete exclusion of mathematics often makes it impossible to set forth the arguments leading up to the opinions indicated, the author does succeed in presenting, in concise form, an accurate picture of the views generally held at the moment.

The volume contains the substance of the lectures delivered by the author at Cornell University in 1931–32, as George Fisher Baker non-resident lecturer in chemistry. In an interesting introductory lecture, which will appeal to many whose tastes lie neither in chemistry nor solids, Dr. Desch examines in turn the thesis that "scientific research carried out for the satisfaction of intellectual curiosity is antisocial", the present tendency to substitute for individual workers "the organized labour of skilled teams", and the moral responsibility of the scientific worker for the misuse of his discoveries both in peace and war. He then passes to modern views on crystal growth and crystal structure, rightly pointing out that the block-units postulated by Smekal are much smaller than the units indicated by etch-figures or slip-bands. Next follows an interesting chapter on surface films and passivity ; here it may be right to suggest that the thicknesses ascribed to the "temper-colour films"—quoted from a paper published in 1924—appear to be too low ; Constable, whose optical determinations accord fairly well with the values reached by other experi-

menters using different methods, obtained nearly ten times the thickness assigned to the film on 'straw yellow' steel.

After a discussion of abrasion and solid diffusion, two useful chapters are devoted to the Widmanstätten and martensitic structures, which, it is shown, are closely interconnected. Next Dr. Desch approaches the age-hardening of alloys, intermetallic compounds and the production of a vitreous phase; "the hypothesis of Beilby," he writes, "is out of favour at present with many, perhaps most, physical chemists, but it corresponds so closely with the facts with which the metallurgist is familiar as still to deserve serious consideration". After a chapter devoted to "Chemical Changes in Solids", a discussion of layered lattices and fibre structure closes this exceptionally interesting survey.

The book assembles a wide range of subjects in a limited space, but the reader escapes that sense of congestion which often makes the reading of contemporary chemical literature a penance, in these days when certain publication authorities seem to regard the virtue of a contribution as inversely proportional to its length. The Cornell University Press has contributed to success by clear printing, and the excellent photomicrographs, largely due to the skill of Mr. G. A. de Belin, add greatly to the attraction of the volume. U. R. E.

Science and Everyday Life

(1) *The Laboratory: its Place in the Modern World.* By D. Stark Murray. (The Fen Series, No. 8.) Pp. 117. (London: The Fenland Press, 1934.) Paper, 2*s.* net; cloth, 3*s.* net.

(2) *Science in an Irrational Society: delivered at Conway Hall, Red Lion Square, W.C.1, on April 25, 1934.* By Prof. H. Levy. (Conway Memorial Lecture.) Pp. viii+82. (London: Watts and Co., 1934.) 2*s.* net.

IN the establishment of right relations between science and the community to-day there are two primary tasks: on one hand the education of the community as to the meaning of science and its methods and the bearing of scientific work on everyday problems, and on the other hand, the stimulation of a true appreciation on the part of the scientific worker himself of the social aspects of science. Valuable contributions to both of these tasks are made by the two little books under review.

(1) Mr. Stark Murray gives a popular but well-balanced exposition of the functions of the laboratory in the modern world and the services it renders to industry and to the State alike. It is one of the merits of his book that he endeavours to rend the veil of mystery with which the laboratory worker is frequently surrounded in the public mind and to set forth his achievements in ways capable of general appreciation.

On the whole, Mr. Murray has done his work well. Without burdening the book with unnecessary details he indicates the romance with which scientific work is often surrounded, and its great possibilities in the service of the community. He succeeds in relating it to the everyday life of the ordinary citizen and in indicating, too, the human or personal problems of the scientific worker himself. Much of the material of the book is drawn from pathological work, and in this respect alone the book would afford a useful example of the way in which relations can be established between the scientific worker and the public, based not on a sense of mystery but on a respect springing from mutual appreciation and understanding.

(2) Prof. Levy addresses himself to the rather more difficult task of formulating an adequate philosophy of the place of science in society. He delivers a frontal attack on the traditional abstraction of the laboratory worker from the ordinary affairs of life. Man is at once a piece of matter, an individual and a social being, and the method of science to search for useful isolates may easily lead the scientific worker to overlook the reactions of his social environment on his own scientific work. Scientific workers too readily forget that they themselves are an element of society. Although science is essentially an objective examination of material processes, it is none the less a human activity and there must be a subjective aspect to the objective operation. Prof. Levy exposes the weakness of the distinction which many are so ready to draw between 'pure' and 'applied' science. Science involves ordered and systematic knowledge, not the indiscriminate compilation of observed data. The data must be arranged in a logically cogent form and this continuous interplay of thinking and acting is bound to be affected by human needs and human desires. Even the choice of the problems to which the man of science devotes himself is frequently restricted—almost determined—by social forces of the existence of which he is scarcely conscious.

The appreciation of this aspect of the mutual influence of science and society is important when we come to consider science as a factor in the solution of social problems. In discussing the scope of human laws, Prof. Levy points out the insufficient data on which many of the deductions of eugenists are based, and suggests that scientific deductions in this field are scarcely possible until a new order of society has been created in which a standardised social environment is a possibility.

Inevitably, Prof. Levy's argument leads him into a controversial field. He raises issues, however, which must be fairly faced by those who are concerned with the social consequences of scientific discoveries and wish to assist man to regain control over events. As he points out, to experiment with society involves changing the *status quo*—it means making social history. To the extent to which the application of scientific discoveries has opened up new vistas of social possibilities and intellectual interest, science is a part of society's system of production.

Even those who find themselves reluctant to accept Prof. Levy's conclusions as to the breakdown of the capitalist system and the incompatibility with progress of a wage system coupled with production for profit, should be grateful for his exposition of the real issues. The isolation of the man of science is a thing of the past. Science has both essential and environmental properties. There is not and cannot be a standardised, unchanging static environment, and this stimulating lecture should assist many scientific workers to think out their own position in relation to the changes which are being produced by the mutual reactions of science and society.

R. BRIGHTMAN.

A Crystallographic "Arrowsmith"

The Search. By C. P. Snow. Pp. 429. (London: Victor Gollancz, Ltd., 1934.) 8*s.* 6*d.* net.

It is curious that in spite of the overwhelming influence exercised by science on our civilisation, there have been so few attempts to express its ethos in literature, especially in the field of imaginative romance. Many causes have probably contributed to this, not the least of which has been the fact that most writers are not in any sense within the boundaries of science, and have to take those essential structural details on which the whole complex of human relations must depend, at second or third hand. For this reason a book such as John Masefield's "Multitude and Solitude", which deals with medical research in Africa, gives always a shadowy impression, failing to inspire confidence in the probability of its main theme. The "Martin Arrowsmith" of Sinclair Lewis, in contrast, is a much more powerful book, and most of those who buy "The Search" will probably place the two novels side by side on their shelves.

It may be said at once that these purchasers will be many, and that "The Search" will rightly receive the general applause due to an almost unqualified success. It is to be noted, moreover, that the achievement is in more than meets the eye, for by the selection of crystal physics as his protagonist's subject, Mr. Snow abandons the popular appeal of the struggle against death and disease. The novel is in autobiographical form, and after a perhaps too Wellsian introductory childhood, describes the life of a student at the University of London and his first researches both there and in Cambridge. This is all excellent, becoming at times intensely exciting, with only traces of over-dramatisation. It leads on to an account of the proceedings of a committee appointed to set up a research institute, which is one of the most brilliant studies in character we have read for a long time. In the midst of this, the protagonist, who hopes for the post of director, becomes involved, somewhat to his detriment, in an unfortunate polemic, which destroys his chances. After some years of further work he leaves science altogether and takes up social and political writing.

The parallels with "Martin Arrowsmith" are striking, though until we have finished the book, we are not at all conscious of them. Like Martin Arrowsmith, Arthur Miles struggles in the realms of methodological imperfection, and as the former failed to maintain his controls during the island plague, so the latter puts unjustifiable trust in some data obtained by his assistant, with depressing results. The women, too, arrange themselves similarly, for though Leora and Audrey are admirably and sympathetically drawn, Joyce and Ruth are but flat characters.

Of criticism, perhaps the most serious that might be made is that Mr. Snow does not sufficiently make clear the nature of Arthur Miles's second enthusiasm. What is this for which an on the whole so successful scientific worker lays down his overall and slide-rule? We are given to understand that the psychological and political education of mankind comes to seem more important to him than the search for detailed scientific truth. But the outlines of this need greater clarity. Had he turned to propagate a robuster political faith, this would not have been so necessary as it is when his aims seem so mild and moderate, so Lowes-Dickensonian, so L. N. U.

In sum, we have in "The Search" a really important study of human life as it is lived in the world of science. If Mr. Snow can push on along this line, we are not willing to suggest bounds for his possible achievement. But it will need a more definite socio-political outlook, and all the understanding that the closest and most sympathetic observation of human behaviour can give, whether it be of shop-assistant, railwayman, biologist, or parish priest. The results of such a life work are certainly no less valuable than a hundred papers in Proceedings and Transactions.

J. N and D. N.

Short Notices

Folklore and Archæology

Virgil the Necromancer : Studies in Virgilian Legends. By J. W. Spargo. (Harvard Studies in Comparative Literature, Vol. 10.) Pp. xii+502+27 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1934.) 21*s.* net.

It is unlikely that Comparetti's study of the legends which grew up around the name of Virgil in the Middle Ages will be superseded; but since its first publication towards the end of last century, the science of folklore has made considerable advances, and there are certain aspects of the legends which Comparetti did not consider.

It was very generally held that Virgil had prophesied the coming of the Messiah; but this scarcely accounts for the fact that in popular belief he was credited with magical powers. Then it was believed, or rather story had it, that he constructed a fly of bronze which kept the flies out of Naples; he built a market in which the Neapolitan food-supply would keep fresh for five hundred years; and he is supposed to have fashioned human figures of metal which had magical powers of varied kind. This is only a small fraction of his achievement. Comparetti regarded these stories of Virgil's wonder-working as a folklore version of his literary reputation as an inspired *vates*; but in so doing he overlooked the fact that these legends do not appear until late (twelfth century), and had they originated in the way he suggests, some earlier version would have survived. Dr. Spargo has investigated the source of these tales and shows that they belong to the common stock of medieval legend. Specific variants can be traced, on one side to India, on the other to Germany, and he argues that they were attached to Virgil in Italy as a local celebrity, just as they might have been attached to any other semi-legendary, semi-heroic character of local fame.

While Dr. Spargo does not present an irrefutable case, folklorists will agree that his view of the origin and growth of the legends as an attribute of Virgil has not only a strong element of probability, but also is in accordance with the manner in which popular traditions gather around the names of great men elsewhere and in other times. His account of the Virgilian legend and of its distribution and later history makes an entertaining volume, of which the illustrations from contemporary prints are not the least interesting feature.

The Mystic Mandrake. By C. J. S. Thompson. Pp. 253+8 plates. (London: Rider and Co., 1934.) 15*s.* net.

Mandragora (*Mandragora officinarum*, Linn. var. *vernalis Bertolini*) is one of the most ancient of medicaments. Its qualities as an agent of narcosis and anæsthesia were known to the Greek and Latin writers, and knowledge of its use for this purpose in connexion with surgical operations had reached the Chinese. In the poets and imaginative writers, especially of the Elizabethan period, it is coupled with the poppy as a producer of sleep and forgetfulness.

Mandragora, however, is best known under the name of the mandrake, for its magical properties. It was supposed to be an aphrodisiac and to ensure fertility in women. For this purpose not only was it used in the form of a drug, but also its supposedly human root was a powerful amulet. In form it was either male or female; and when it was pulled from the ground, its shrieks caused the death of its hearers. The sound was, therefore, drowned by a trumpet as the root was pulled from the ground by a dog, which immediately fell dead. Representations of the operation are frequent in medical manuscripts and herbals of the Middle Ages. Mr. Thompson reproduces several of these. In England, owing to the scarcity of the mandrake, its magical properties came to be attached to the root of briony, and the belief still survives in attenuated form.

Mr. Thompson has followed the history of the mandrake superstition from the earliest times and among various peoples, Hebrews, Arabs, Greeks, Romans, Chinese and medieval Europeans. An interesting development was the artificial mandrake, which had a ready sale for magical purposes, especially in Germany, in the Middle Ages. This suggests a connexion with magic and witchcraft rather than a belief in a tree-spirit, to which Mr. Thompson inclines.

Historical Studies

The Renaissance of Medicine in Italy. By Prof. Arturo Castiglioni. (The Hideyo Noguchi Lectures.) (Publications of the Institute of the History of Medicine, the Johns Hopkins University, Third Series, Vol. 1.) Pp. xiv+91. (Baltimore, Md.: The Johns Hopkins Press; London: Oxford University Press, 1934.) 7*s.* net.

This series of three lectures is preceded by an intimate picture of Prof. Castiglioni by his brother historian Prof. Henry E. Sigerist of Johns Hopkins University, where the lectures were delivered in 1933 at the Institute of the History of Medicine.

In the first lecture, which deals with the dawn of the Renaissance in the life, art and science of Italy, Prof. Castiglioni maintains that the three characteristic features of the Italian Renaissance were the individualistic conception of man as the centre of the cosmos, the passion for study and research independently of religious faith and scholastic doctrine, and the return to the Greek understanding of beauty, considered as harmony of shape and function. All these characteristics were admirably represented in Leonardo da Vinci, who was the complete type of the universal man as well as the initiator of physiological anatomy.

The second lecture contains a description of

medical studies in Italian universities at the time of the Renaissance, with special reference to the work of Alessandri Achillini (1463–1512) of Bologna, whose text on anatomy showed the first attempt to correct Galen's errors, Berengario da Carpi (1470–1530), the first to study the anatomy of the brain, to describe the position of valves and to examine carefully the vocal organs, Gian Battista Canano of Ferrara (1515–79), the third forerunner of Vesalius, whose work is then described, and Andrea Cesalpino, another universal man and the first to affirm that the organ of sanguification was not the liver but the heart.

In the third lecture, Prof. Castiglioni emphasises the importance of the work of Fracastor in relation to contagious diseases in general and syphilis, typhus and phthisis in particular, and concludes with a study of Galileo's work, which is described as not only creative in the field of astronomy but also as a renewal of all scientific thought from its foundations.

Jöns Jacob Berzelius. Autobiographical Notes published by the Royal Swedish Academy of Sciences through H. G. Söderbaum. Translated from the Swedish by Prof. Olof Larsell. (History of Science Society Publications, New Series 6.) Pp. xi+194. (Baltimore, Md.: The Williams and Wilkins Co., 1934.) 2.50 dollars.

THIS translation of the "Autobiographical Notes" Berzelius gave to the Swedish Academy of Sciences in 1823 and 1842 provides an interesting background to the state of science at the beginning of last century. At that time the rules of the Swedish Academy prescribed that each member should present his *Curriculum Vitæ* as soon as elected, and should contribute additions after every decade.

Berzelius fulfilled these obligations, setting out in great detail the story of his early struggles and frustrations, his travels and ultimate successes. Only brief mention is made of his actual discoveries, and nothing is said of his influence on the development of chemistry beyond the inclusion of a list of his students who attained eminence. He does, however, give valuable details concerning his meetings with English, French and German contemporaries, and sometimes expresses an opinion upon their work and character.

The Swedish version was published in 1901 under the editorship of Prof. Sõderbaum, and is the basis of this English edition by Prof. Olof Larsell.

Combustion from Heracleitos to Lavoisier. By Joshua C. Gregory. Pp. vii+231. (London: Edward Arnold and Co., 1934.) 10*s.* 6*d.* net.

THIS is a dramatic book and should be read as such, for though it does not deal with the journeyings of men and women, of their love affairs and battles, yet it has relation to a subject old as man himself, that of fire. As long as there has been human thought, it must have struggled to understand fire; many civilisations got no further than worshipping it, until at long last there came a man, Lavoisier, who raised the curtain of ignorance and disclosed the rôle of oxygen in the kindling. In fact, it was not until systematic experiment took the place of dogma—and this did not happen until the seventeenth century—that the real facts of combustion could be elucidated and the phlogiston theory laid to rest. To-day we still concern ourselves with the mechanism of combustion and the order of events, but the points of issue are but minnows compared with the tritons of old.

The modern chemical student, alas, has no leisure and seeks only to acquire facts, but there are still some who wish to acquire taste maybe in literature or in the other good things of this life. To such we recommend Mr. Gregory's book for edification and profit. Many have mused before a brightly burning fire of this and that and written out their thoughts for posterity to enjoy; not a tithe of the musers have been curious as to what is happening in the fire. So it is still: curiosity is a character which dies very young and scarcely anyone asks why. Fortunately, there is a sufficiency of those who do so to carry the world forward at an ever increasing rate as science spreads but, as the subject of combustion illustrates, this was not always so. The book makes close reading, but the philosophically minded will not regret the labour, or close it without a debt of gratitude to its author, who surely must have enjoyed writing it. E. F. A.

Nature Study

Scolt Head Island: the Story of its Origin, the Plant and Animal Life of the Dunes and Marshes. Edited by J. A. Steers. (Published for the Norfolk and Norwich Naturalists' Society.) Pp. xvi+234+34 plates. (Cambridge: W. Heffer and Son, Ltd., 1934.) 15*s.* net.

SCOLT HEAD ISLAND, a narrow strip of land some four miles long off the coast of north Norfolk, between the harbours of Brancaster and Burnham—now the property of the National Trust—is likely to become famous. At any rate it will serve as a model station for the study of ecology, that is to say of the inter-relations between wild plants and animals, and their relation, in turn, to their physical environment. Much that has been written on this theme makes somewhat tiresome reading. But in this small volume every page is of absorbing interest. The idea of securing this small stretch of the Norfolk coastline as a Nature reserve originated with Prof. F. W. Oliver, and was eventually brought to achievement by the enthusiasm of Dr. Sidney Long, one of the foremost of living Norfolk naturalists.

It would require a very long review to do justice to this remarkable volume, which has set a standard of what such a survey should be. Here we have set down for us, in most lucid fashion, the effects of shifting sand and scour of the tides in moulding and changing the form of the island, and their effects on the vegetation of the island. These variable factors form, so to speak, the basis of the book. In the following chapters, botanists and zoologists whose names inspire confidence give the results of their researches, which others are invited to carry on,

comfortable quarters being provided on the island, enabling students to make the prolonged stay necessary for sound observation work.

The history of the plant life, by Mr. V. J. Chapman, is extraordinarily interesting; and no less so is Miss E. L. Turner's account of the breeding birds. The treatment of the less familiar mosses and lichens and the marine invertebrates displays a knowledge as intimate and a skill in presentation as certain as that of the more familiar and more popular themes just referred to.

Our Garden Birds: their Food, Habits and Appearances. By H. Mortimer Batten. Pp. 192+39 plates. (London and Edinburgh: Thomas Nelson and Sons, Ltd.; T. C. and E. C. Jack, Ltd., n.d.) 5*s.* net.

THIS book will make an irresistible appeal to those who have an affection for the birds which add so much to the joy of our gardens. For the author writes of them evidently with an intimate, first-hand knowledge, and with a directness and simplicity of style which one rarely finds in books on this well-worn theme. An added charm is given by the unusually good coloured plates. These, apart from their unquestionable artistic merits, will prove of the greatest help to many of those readers whose knowledge, even of our common birds, is limited.

There is one statement made by the author concerning the lapwing which will cause no little surprise among ornithologists of experience. This statement is to the effect that it is getting too numerous in certain localities, and farmers are complaining of its change of food and habits. Surely the author should either not have made this charge, or he should have supported it by some show of evidence. We venture to think these charges are quite unfounded.

The author's description of the habits of the various species, forty in all, makes delightful reading, and they are all, obviously, from his own observations. His very beautiful coloured plate of the tree-sparrow, one of the best we have ever seen, should be welcome. For few people recognise this bird even when they see it. But the author does not tell his readers that one of the most characteristic features of the tree-sparrow, next to the conspicuous cheek-spot, is the chestnut-red crown, and that male, female and young all wear the same livery, whereas in the house-sparrow the female differs markedly from the male, while the young have a livery of their own, though very like that of the female. But for all this, it is an excellent book and should find a place on the shelves of every bird-lover.

The Life of the Rook. By G. K. Yeates. Pp. 96+16 plates. (London: Philip Allan and Co., Ltd., 1934.) 10*s.* 6*d.* net.

THE best first-hand account we have read of the daily habits of the rook in rookery and roost. The author is sometimes inclined to speculate hazardously, as when he suggests that the female rook visualises in courtship the stages of the life-history (although in her first breeding season she can have no experience of these stages), and he deliberately avoids discussion of the economic side of the rooks' behaviour. However, his observations are careful, his explanations of conduct on the whole reasonable and illuminating, and his photographs as near perfection as may be. He also tells how to construct a hide in the tree-tops.

Highways and By-ways

The Place-Names of Surrey. By J. E. B. Gover, A. Mawer and F. M. Stenton, in collaboration with Arthur Bonner. (English Place-Name Society, Vol. 11.) Pp. xlvi+445. (Cambridge: At the University Press, 1934.) 21*s.* net.

WITH a few exceptions, Surrey place-names are entirely English. The Celtic element, which to the English place-name hunter is in the nature of a plum in the pudding, here survives only rarely, although curiously enough, in the south-west, names indicating a connexion with pagan centres of worship are more numerous than in any other area of equal size in England. One example, to which attention is directed, is Tiusley near Godalming, which probably refers to a sacred grove of the god Tiw. Another name, which has now disappeared, but is recorded in an early document, is Cusan *weoh*, which is taken to mean the temple of (belonging to) Cusa. This is remarkable in view of the fact that while the element *weoh* is of fairly frequent occurrence in the midlands and south, the only known similar conjunction with a proper name is Patchway in Sussex. These survivals of Saxon paganism suggest a late, or more possibly a difficult, conversion to Christianity.

The significance of the name Surrey is by no means clear. The obvious explanation that it is the 'southern province' does not accord with the fact that no dynasty of the Middle Saxons is recorded. The authors suggest that a loose association of two peoples, of whom one was on the south side of the river, may have existed before the northern came under the Mercians and the southern was in turn acquired by the kings of Kent, Mercia and Wessex.

Admiration for the excellent work which is being done by the English Place-Name Society grows with the publication of each volume of its survey. The attention now given to field names, which appeared for the first time in the previous volume covering Northamptonshire, much assists the student. Of the appendices which close this volume, one by Mr. Arthur Bonner deals with the much discussed Cold-harbour and another by Prof. Bruce Dickins discusses head-names of the type of Shepshed, Swineshead and the like—survivals of much interest to the student of pagan beliefs in Britain.

From Track to By-Pass: a History of the English Road. By T. W. Wilkinson. Pp. xvi+240+39 plates. (London: Methuen and Co., Ltd., 1934.) 10*s.* 6*d.* net.

THE preparation and maintenance of roads has become an important industry into which science is beginning to penetrate. Although their present is definitely more important than their past, there will

be many who have a very real interest for the roads of rural England regarded as something more than speed tracks, and to these a history of the development of the English road from a track to the latest speedway or by-pass will appeal. Mr. Wilkinson knows his subject and, what is as important, has real affection for it, so that he has produced a book which is as entertaining as it is educative.

It is remarkable that only twice before in our long history have we built roads in England, once when the Romans did so to conquer and to hold it, and again, after a long period of neglect, during the coaching era in the early part of the nineteenth century before the advent of what Macadam dolefully called "the calamity of railways".

Mr. Wilkinson tells us the lore of the roads, including the technical work of Telford and Macadam, and it is perhaps worth emphasising how scientific road-making has now become. There is a Road Building and Materials Section of the Society of Chemical Industry and a Road Tar Association, as well as sundry specifications for road materials from the British Standards Institution: much research is going on to make the most permanent non-skid, dustless roads requiring a minimum of upkeep.

Gone Rustic. By Cecil Roberts. Pp. 318+4 plates. (London: Hodder and Stoughton, Ltd., 1934.) 7*s*. 6*d*. net.

In sending a copy of "Gone Rustic" to Nature for review, the publisher was not so greatly daring as might seem at first sight. For though there is nothing in this book which, even by a stretch of imagination, could be called 'scientific', yet there can be few readers of Nature who will not revel in its delightful pages. Here, when one is feeling jaded, will be found refreshment as delicious as a draught of sparkling wine. It has a bouquet all its own. The joy of a garden, and the restfulness of the country, many of us know well, but it has been left to Mr. Cecil Roberts to give these joys a language which glows and sparkles in continual effervescence. Our mistakes, our trials and our triumphs as gardeners are delightfully recalled to us. They are, indeed, *our* experiences, but we have had to wait for him to show us that even our failures should not mortify us, and to express that quiet satisfaction with a life in the country which refuses to be caught, and set down, by any other pen than his.

So vivid are his scenes, so life-like the people he portrays, that one feels that whether this is wholly a work of fiction, or wholly a work of fact, it is, in either case, supremely good.

Local Colour: a Landscape Analysis for Sightseers. By Edmund Vale. Pp. xvi+275. (London and Toronto: J. M. Dent and Sons, Ltd., 1934.) 5*s*. net.

This little book is full of that type of information coming under the head of general knowledge which we all should know though in reality so few of us do. But it has the further advantage of inspiring those who dip into it to take a greater interest in all that is around them. Though much of the population nowadays is only concerned to rush around seeing nothing and taking no interest in anything beyond themselves, there is a certain amount of return to the countryside by the hiker, and as the school education takes no note of such a subject, the sightseer must provide his education in landscape analysis for himself. With such a book in the hand, or still better in the head, a day in the country will possess added joys and a field-path will have more significance than being the shortest route between inns. Mr. Vale merits the widest possible public for his effort.

Geography in relation to the Social Sciences. By Isaiah Bowman. (American Historical Association: Report of the Commission on the Social Studies, Part 5.) Pp. xxii+382+17 plates. (New York and London: Charles Scribner's Sons, 1934.) 2.25 dollars.

This work is an attempt to re-write certain portions of modern geography and their bearing on human relationships. It contains excellent photographs, which would have been of greater value had they borne a closer relation to the adjoining text. Emphasis is rightly laid on the importance of a careful consideration of not one but a number of maps of a region before interpreting its significance in human relations. The extended use of italics is unfortunate, and not always conducive to clarity of expression.

In addition to Dr. Bowman's portion of the book, a compendium relating to the teaching of geography in European schools is included, this latter addition being necessarily somewhat cursory. In general, the work falls neither in the category of a textbook nor in that of books suitable for the lay reader.

B. H. K.

Astronomy and Modern Physics

Through Space and Time: based on the Royal Institution Lectures, Christmas 1933. By Sir James Jeans. Pp. xiv+224+53 plates. (Cambridge: At the University Press, 1934.) 8*s*. 6*d*. net.

In this book Sir James Jeans makes available to a wider public the admirable lectures which last Christmas he delivered at the Royal Institution to an audience varying in age from eight to eighty years. As then by the spoken word, so now by the written one, he portrays, in a style and with illustrations that a boy and a professor can alike appreciate, our present picture of the material universe. In the main his subject is astronomy, to which six of the eight lectures or chapters are devoted: they are entitled the sky (chiefly concerned with the astronomy of the ancients), the moon, the planets, the sun, the stars and the nebulæ. The first chapter describes the earth's present constitution, as revealed by earthquake records, and its past history, as disclosed by geology: among the many illustrations (which are a notable feature of the whole book) are several depicting prehistoric animals as 'reconstructed' from their fossil remains. The second

chapter recounts much of our present wide and varied knowledge of the lower and upper atmosphere.

The picture of the universe which is presented is an external one, as seen by supposed travellers making a journey from the earth, through the air, to our neighbours in the solar system and, beyond, to the stars and the nebulæ: the journey is one through time as well as space, for the author ranges over the past and, in some places, the future, as well as the present. Nowhere is the scene "sicklied o'er with the pale cast of thought"; eschewing philosophy and ultimate questions, the wonders of material things are vividly described, with that apt and varied imagery of which Sir James Jeans is a master. The book gives a splendid opportunity both for children and their elders to acquire a really up-to-date acquaintance with the outlines of the knowledge at present afforded by geophysics and astronomy. S. C.

The Mysteries of the Atom. By Prof. H. A. Wilson. Pp. viii+146. (London: Chapman and Hall, Ltd., 1934.) 10*s.* 6*d.* net.

NEW facts and new ideas in physical science are described by Prof. H. A. Wilson in this book on the mysteries of the atom. The author was one of the band of pioneer investigators in the Cavendish Laboratory, Cambridge, when the electron was discovered and its properties measured. Due prominence is given to the important contributions of J. J. Thomson and his fellow workers to the fundamental identification of the negative electron as a constituent of matter. "There is some truth in this, that many things have an epoch, in which they are found at the same time in several places, just as the violets appear on every side in the spring" (Bolyai).

The first chapter of the book contains an outline of the classical view of matter and electricity, and the following chapters describe the new discoveries and show how these have led to new views. "Determinism," says Prof. Wilson, "has definitely gone, for the time being at any rate, so that the idea of free will is no longer untenable". He concludes that "the laws of nature appear to have been designed so as to allow the course of events to be guided from outside without any violation of the laws".

One minor criticism may be made. The reviewer cannot approve the use (defended in Appendix I) of the term 'weight' in this book as equivalent to 'mass', employed in such expressions as 'charge per unit weight of electrons'. It would have been a simple matter to have explained the difference between these terms in the first chapter.

The book as a whole achieves the object of providing a plain and interesting account of modern physics. H. S. A.

The Diffraction of X-Rays and Electrons by Amorphous Solids, Liquids and Gases. By J. T. Randall. Pp. xii+290+31 plates. (London: Chapman and Hall, Ltd., 1934.) 21*s.* net.

THIS is really an excellent book on an interesting topic written in a clear and convincing manner with many suggestive remarks. Whilst the application of X-ray and electron diffraction methods of investigation are now a matter of routine both in the research laboratories and in industry to materials in the form of crystalline solids, it is only recently that the methods have been applied to the elucidation of the structure of gases, liquids and amorphous solids. A general survey of the principles of X-ray crystallography is first given and the method of application of these principles to microcrystalline systems and single molecules is then discussed. Whilst some advance in the application of X-rays to the investigation of liquids has been made, it is interesting to note that but little work has been carried out on the diffraction of electrons by liquids, a field of undoubted importance especially in connexion with the problem of lubrication. Some fifty pages are devoted to the structure of important substances such as glasses, coal and fibres, including an excellent although short account of Astbury's work on the proteins. The last chapter is devoted to the results obtained in investigating the phenomena of melting and liquid crystals.

It is evident from the ample documentation that the author has taken great pains to ensure that no paper of importance should be overlooked, and although as a result in some sections the effects of compression are to be noted, the author is to be congratulated on the results of what must have been a difficult but extremely valuable piece of work. E. K. R.

Miscellany

Sea Fishing. By A. E. Cooper (Editor), the Marquess of Sligo, Eric Parker, Louis Babcock, P. N. R. Bartlett, A. F. Bell, C. Leo Biden, G. Bonnaire de Maupas, Van Campen Heilner, T. E. Donne, O. W. Fenney, A. Fraser-Brunner, "Seangler", F. B. Hannam, J. R. Harris, C. S. Patterson, "Pelican", J. A. Sturch, W. K. Summers, Fred Taylor, etc. (The Lonsdale Library, Vol. 17.) Pp. 352+86 plates. (London: Seeley, Service and Co., Ltd., 1934.) 15*s.* net.

HERE we have a thoroughly up-to-date guide to sea fishing for sport—rod and line—in the format of the Lonsdale Library which has superseded the old Badminton, the delight of our youth. It is essentially a practical manual covering rods, gear and bait, spinning and casting, while the actual handling is indicated under each fish. The fisherman's first thoughts are directed to weather and boat management, the neglect of the theory and practice of which has cost many lives.

The fish are arranged according to modern classification, not habitat, and this is wise, for the likes and dislikes of fish and the mode of application of their strength show classificatory affinities as well, if judged by our text. Twelve sharks and dogfish and fifteen skates and rays are referred to, of which only about a third are regarded as sporting fish. Next follow the bony fishes, but the chapters dealing with fish after fish, considered by different authors, are often of textbook type and hence uninteresting to

the general reader. We fancy that this is due to the editor's necessary pruning, but all fishermen would like to know more of the eel's migrations, and the slip, 16,000 fm. of depth, for the breeding conger must be corrected. The cod and its allies are the commonest of sea fish, while the mackerel and tunny are recommended for enjoyment and the highest form of sport. Then follow chapters dealing with South Africa, New Zealand, the tarpon, the bone fish and fish mounting and modelling.

We suggest that the first appendix treating of "The External Features of Sea Fish" should be inserted before the "Contents" since its understanding is critical to so much of the subsequent text.

The form of the book pleases, its paper and illustrations are attractive and it is a necessary and desirable addition to the bookshelf of every fisherman —and perhaps yachtsman also.

Simple Science. By Prof. E. N. da C. Andrade and Prof. Julian Huxley. Pp. xi+688. (Oxford: Basil Blackwell, n.d.) 8*s.* 6*d.* net.

PROFS. ANDRADE and Huxley offer their readers a "plain tale of the great intellectual adventure that characterises our age". The days are gone when one man could survey the whole realm of science, even to the extent of giving an elementary but balanced account of its fundamentals. The solution would appear to be the collaboration of a physicist and a biologist—with the proviso that both should be skilled interpreters of the story of science. In Profs. Andrade and Huxley we have such a combination; both have distinguished records as men of science and both have a flair for popular exposition. The result of their work is a connected descriptive account which makes a useful basis for a general course in the fundamentals of science. Indeed, the authors state that the material of the book was originally written "for young people", but that the present somewhat bulky edition has been issued with the aim of attracting the general reader.

Part I, entitled "Things Around Us", contains elementary notions on the states of matter, gravity, the atmosphere, water and life; Part II is largely physiological; and Part III, entitled "Forces at Work", has chapters on electricity, magnetism, light and chemistry, in which the everyday and industrial aspects are emphasised. The text contains many useful analogies and descriptions of 'neat' experiments. The only quarrel we have is with the illustrations; in many cases, sketches seem to have been prepared from photographs when reproductions of the photographs themselves would have been more useful.

Fog. By Alexander McAdie. Pp. 23+52 plates. (New York: The Macmillan Co., 1934.) 10*s.* 6*d.* net.

THIS is an unusual type of work, for it contains only fourteen pages of printed text, the bulk of its contents consisting of the reproduction of fifty-two photographs. Most of these have been taken by the author, but a few are from other sources such as Fontseré's "Atlas de Núvols". The title "Fog" is perhaps a little misleading, for only eight of the fifty-two photographs represent fog in the ordinary meteorological sense, and the preliminary discussion includes subjects not very intimately connected with fog proper, such as Aristophane's satirical play "The Clouds", the question as to the best unit in which to express atmospheric pressure, and the artificial production of rain. It appears that Prof. McAdie in this work uses fog in its widest sense, for he remarks (p. 12) that "Every fog is a cloud, only it is a cloud that rests upon earth. Conversely every cloud is a fog only it is lifted by rising air and shaped by losing energy, chiefly caused by the winds".

The photographs, many of which have appeared in earlier publications by the same author, illustrate some remarkable fog formations such as fog pyramids (Pl. VI), fog cascades (Pl. I) and fog surges (Pl. V), with which most British meteorologists are probably not familiar. In addition to photographs of clouds and fog there are a number illustrating lightning flashes, snow and frost crystals and optical phenomena such as the solar halo and corona, and a very fine one (Pl. XXIV) of a waterspout, taken apparently from an aeroplane. The reproduction does not strike one as quite up to the best standards, for in many cases the whole photograph looks excessively dark and in others the contrasts are so strong as to give the cloud a somewhat unnatural appearance. This last fault is most noticeable with the cirrus clouds.

E. V. N.

The Conquest of Suffering. By Ritchie Calder. Pp. xvi+166. (London: Methuen and Co., Ltd., 1934.) 5*s.* net.

MR. CALDER is avowedly a journalist, using the familiar devices of journalism in his method of presentation, but he writes with the ardour of an earnest social reformer, inspired by deep conviction of the essential justice and rightness of the cause which he pleads. His aim is to stimulate, by enlightened public opinion, State and municipal action to utilise adequately the results of modern scientific investigations which have shown how to prevent and to cure disease. Few will quarrel with this aim in a world where vast hordes of people are receiving less than the amount of nourishment which nutritional science has shown to be essential for the maintenance of health, while large supplies of 'surplus' foodstuffs are being destroyed, and where countless human beings are suffering and dying from preventable diseases. The achievements of medical science, faithfully served by the adjunctive sciences of chemistry and physics, are attractively and accurately presented with a restraint and freedom from exaggeration seldom found in propagandist works.

The scope and purpose of the book are briefly stated in an introduction by Prof. J. B. S. Haldane, and the list of eighteen eminent authorities who have contributed the facts and in many cases the opinions quoted by the author are themselves a guarantee of the essential accuracy of this small volume. It may be commended, not only to the lay reader for whom it is intended, but also to scientific persons who are interested in the development of public health and preventive medicine.

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observed on each occasion. With a tuned receiving set, of relatively low decrement, and recording with a galvanometer which has a relatively long natural period, the constituent parts of the atmospheric are merged together, and hence the duration recorded is that of the whole succession of pulses, that is, the duration as it would appear to a broadcast listener.

Visual observations of lightning flashes made in Toowoomba indicated that these lasted, in many cases, for an appreciable fraction of a second. (This has also been observed by Schonland, Collens and others.) In some cases, multiple flashes were observed by eye in which two or more flashes traversed the same path in relatively rapid succession, but with a definite interval of darkness separating them. In one case four such flashes were observed. Presumably this merely indicates an unusually long interval between successive constituent flashes. This phenomenon is reproduced in observations with the cathode ray direction-finder, in which, in an unexpectedly high percentage of cases, two atmospherics in succession come from the same direction.

It should be pointed out that the flashes observed by us were mostly cloud–cloud flashes, whereas Schonland and Collens appear to have worked mostly on cloud–earth flashes. Schonland and Collens's photographs show a thicker (more intense ?) track close to the *ground*, although the branching is away from the *cloud*. Photographs taken by us show a thinning-out in the direction of branching, indicating a somewhat different mechanism in the propagation of the flash.

The atmospherics dealt with in the above discussion are of the type sometimes known as 'grinders'. Sometimes an atmospheric occurs which consists of a single pulse, this producing a 'click' in a broadcast receiver.

The observations with the Einthoven galvanometer were carried out by Dr. A. L. Green at Liverpool (near Sydney).

G. H. MUNRO.
H. C. WEBSTER.
Commonwealth Radio Research Board,
Melbourne.
Oct. 8.

[1] *Proc. Roy. Soc.*, **111**, 165, 654; 1926.
[2] *Proc. Inst. Rad. Eng.*, **15**, 985; 1927.
[3] *Proc. Roy. Soc.*, A, **143**, 654; 1934.
[4] NATURE, **131**, 765, May 27, 1933.
[5] *Phil. Mag.*, **15**, 409; 1933.
[6] *Ann. Phys. u. Chem.*, **68**, 776; 1899.

Electrical Properties of Materials at High Radio Frequencies

THE accurate determination of the electrical constants of materials becomes progressively more difficult as the frequency at which they are required is increased. The effects of stray capacities and inductances in the measuring apparatus are usually such as to limit the use of ordinary resonant circuits to frequencies below about 10^8 cycles per second. The method described below can be used at much higher frequencies.

If a sinusoidal electromotive force is induced in a parallel wire transmission line immersed in a substance having a dielectric constant K, the distance between two points of the same phase is $1/\sqrt{K}$ times that in a similar line in air. The distance in either case is most readily determined by finding the antinodes of current or potential in the line. When the effect of the conductivity of the material between the wires cannot be neglected, the result is rather more complicated. In this case it can be shown that the distance between two consecutive antinodes of currents or potential in a line immersed in such a medium is not a constant but increases to a limiting value as the distance of propagation in the medium increases. The rate of this increase or the ratio between any two half wave-lengths in the line can be used to determine both the dielectric constant and the conductivity of the medium surrounding the line at the frequency of the inducing E.M.F.

It is usually convenient to have the inducing oscillator and part of the line outside the material under test. The analysis is then much simplified

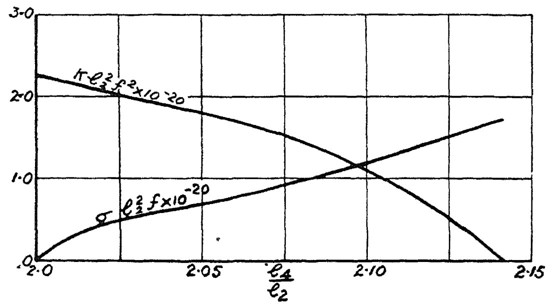

FIG. 1.

if the line is adjusted so that the point of entry to the medium coincides with an antinode of current in the line, as under this condition the effect of the part of the line in air disappears from the analysis. The positions of the antinodes of current in the case of a liquid can be determined by observing those positions of a short-circuiting bridge placed across the wires for which the line is in resonance with the oscillator coupled to it. If the distances between the antinode of current at the entrance to the medium and the positions of the first and second antinodes of current are l_2 and l_4 respectively, the required values of the dielectric constant and the conductivity (in E.S.U.) of the medium for radiation having the

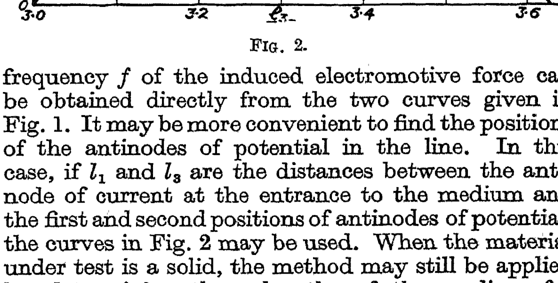

FIG. 2.

frequency f of the induced electromotive force can be obtained directly from the two curves given in Fig. 1. It may be more convenient to find the positions of the antinodes of potential in the line. In this case, if l_1 and l_3 are the distances between the antinode of current at the entrance to the medium and the first and second positions of antinodes of potential, the curves in Fig. 2 may be used. When the material under test is a solid, the method may still be applied by determining those lengths of the medium for which the line enters and leaves the medium at antinodes of current.

The reason that the change in wave-length in a conducting medium has not been observed before is

due probably to the small rate of change in the distances between consecutive antinodes of current or potential. Malone, Case and Ferguson[1] have recently attempted to apply a Lecher wire method to the determination of the dielectric constants of electrolytes. They found apparent inconsistencies in the results when the conductivity was appreciable. They do not give their results in detail, but it is possible that the explanation of them may be found in the change in wave-length with distance of propagation in a conducting medium.

The complete analysis of the method outlined above, together with the results of its experimental application to the study of the electrical properties of soil, will be published later.

J. S. McPetrie.

National Physical Laboratory,
Teddington, Middlesex.
Oct. 24.

[1] Malone, Case and Ferguson, *J. Chem. Phys.*, 1, 842; 1933.

Vision in the Ultra-Violet

In his letter in Nature of November 10, p. 736, Prof. Fabry refers to a statement by Saidman, that vision at short wave-lengths in the ultra-violet is possible only in young people. The continuous retrogression in the limit of visibility is due to progressive absorption with age by the crystalline lens. In his paper, Saidman remarks[1] that the determination of the limit of visibility would give an indication of the age of the crystalline lens.

It is of interest to record that Fr. Exner, who, at the age of nearly seventy years, determined a second time his visibility curve, found a remarkable variation in his own visibility curve from that of the normal eye at the blue and violet wave-lengths[2]. His retina became with increasing age, as he stated, remarkably yellow.

It seems probable that the cause of the limit of visibility at short wave-lengths in the eye of Exner with increasing age was the light absorption in the retina and not only in the crystalline lens.

Herbert Schober.

Technical High School,
Vienna.
Nov. 13.

[1] *C.R.*, 196, 1537; 1933.
[2] E. Haschek, *Wr. Berichte*, 136, 467; 1927.

Possible Action of Cosmic Rays on Living Organisms

During the year 1933, we carried out some experiments to test the action of cosmic rays on white mice. The Kongsberg silver mines west of Oslo served as a convenient working place. The station in the mines was surrounded on all sides by at least 350 m. of ore, thus giving a complete shield for the cosmic rays. The ore consists of basic horneblend which is very poor on radioactive substances, giving a correspondingly small amount of α-, β- and γ-rays. The control station outside the mine was in the basement of a wooden building with free passage for the cosmic rays. The ordinary physical conditions were almost identical on both places, with a comparatively good source of fresh air in the mines. The ionisation measurements of the different rays gave for the total intensity outside the mines 8·58 *I.* and 4·63 *I.* in the mine. The excess of 3·95 *I.* outside is mainly due to cosmic rays.

The animal experiments lasted a little more than ten months. 438 individuals were used, belonging to five generations, of which four generations were born during the experiment. As regards their general condition, no difference between the two groups could be found, either by the examination of the living animals, or at the autopsies. X-ray examination was carried out of the great part of the material, without demonstrable changes of the skeleton. The only difference demonstrable by these investigations was that the animals living in the mine had a greater mean weight than the controls. For the most homogeneous part of the material (animals of 2–6 months of age, born either in the mine or at the control station) the difference was about 2 gm. (the mean difference was 3·2–4·1 per cent for these groups).

Full details of the investigation will be published in *Acta Radiologica.*

Rolf Bull Engelstad.
N. H. Moxnes.

Pathological and Physical Laboratories,
Norwegian Radium Hospital,
Bestun, Oslo.

The Need for Social Research

On many occasions during recent years reference has been made in leading articles and elsewhere in Nature to the need for scientific research in the social sciences with the view of throwing "light on the true causes of many perplexing social phenomena observed both in industry and society"[1]. Several schemes have been proposed, I believe, but nothing apparently has been done. I may be permitted, perhaps, to suggest a line of research which, as it seems to me, would lead to results in the direction named of the highest practical importance; I mean the investigation of the relations which, in a progressive society, should obtain between the State and industry. For many years past, successive Governments have been making laws and regulations of many kinds which have affected our industries in all manner of ways. These laws and regulations must have produced many changes in many directions. What are these changes? Are they beneficial? Are they harmful? Science has not answered these highly important questions; nor does it seem to occur to anyone, not even students of social science, to inquire; and yet it should scarcely be necessary for me to remind men of science generally and sociologists in particular that the industries of society bear the same relation to the body-politic that the alimentary organs bear to the animal-body. When anything goes wrong with our own alimentary organs due to mistakes or ignorant treatment by ourselves, we know what happens; and it surely is not difficult to see that similar disturbances must occur to industry due to any mistakes or ignorant treatment to which they may be subject.

That these disturbances are being produced in industry there is much evidence to show. Many protests have appeared in the public Press from leading business men against this incessant State interference. What is wanted, however, is a collection of the facts upon which the opinions expressed are based, with the view of basing scientific conclusions on them. Facts of the kind indicated are to be had in abundance. I have myself collected them in a small way, and they all point in the same direction— the troubles of industry come from State interference.

Now that the British Association has, as I understand, adopted Sir Norman Lockyer's policy "to promote the application of scientific methods and results to social problems and public affairs", here is a way in which that policy might be put into operation with every hope of reaching conclusions which would be of the utmost practical use.

The world of science would the better realise the condition of industry to-day if its workers could conceive the science research laboratories of the country subjected to regulations, restrictions and increased expenses similar to those under which industry is struggling to-day. As it would be with science under such conditions, so is it now with industry. Both are skilled occupations which have to be conducted in ways known only to those who have the requisite knowledge of them. We must not suppose that the members of either of the Houses of Parliament who legislate for industry, or the Government officials who put their laws into operation, have a sort of super-knowledge and wisdom which fits them to control skilled occupations in such a way as to help forward such work, or enables them to guide social and economic activities to the general advantage. Have they passed examinations, or taken their degrees in these subjects? Or have they in any other way qualified themselves for work of this extreme difficulty and risk? Not at all. We must reluctantly admit that, after all, they are men with no special training either in science or industry, and their particular skill seems to lie in hindering those who have.

Herbert Spencer strongly advocated a research of the nature suggested many years ago: if it was needed in his day, our need is far, far greater to-day.

ALAN BLAIR.

Meir,
Stoke-on-Trent.
Oct. 31.

[1] NATURE, 134, 393, Sept. 15, 1934.

Breeding Habits of Hornbills

ALTHOUGH the extraordinary breeding habits of hornbills have excited comment for many years, little is actually recorded except that the female is walled up in a natural hole, where she is fed by the male through a slit and undergoes a complete moult. Practically no one who has left notes has resisted the temptation to destroy the nest before the story was complete.

Recently Mr. S. A. Child has made observations at Longido on the small hornbill, *Lophoceros deckeni*, without interfering in any way with the nest. He found that the female was enclosed for not more than 58 days (53 ± 5). Directly she emerged the hole was resealed, and she helped the male to feed the two young for another four weeks. A similar habit was recently established by Hoesch[1] for *Lophoceros flavirostris leucomelas* in South-West Africa, and Schönland[2] had inferred it years ago for *L. melanoleucos*. The habit is, therefore, probably generic.

We have had a nest-hole of the big forest hornbill, *Bycanistes cristatus*, under observation near Amani for two successive seasons. The female did not emerge until the young were ready to accompany her. The dates she began to sit are known only within about four weeks; the dates of emergence are fixed exactly. She was immured for the astonishingly long periods of 159 days $\pm$ 16 and 137 $\pm$ 14 respectively. During these five months, the male was solely responsible for provisioning his family and, on the average frequency we observed for his visits, he brought food at least three thousand times.

R. E. MOREAU.

East African Agricultural Research Station,
Amani, Tanganyika Territory.
Oct. 20.

[1] *Orn. Monatsber.*, 41, 97–106; 1933.
[2] Stark, A. C., and Sclater, W. L., "Fauna of South Africa", vol. 3, 1900–6.

Development of *Salmacis bicolor*, Agassiz

MORTENSEN's "Echinopluteus of Temnopleurid ? species A"[1,2] is undoubtedly referable to a *Salmacis* species as suggested by Tennent[3]. The latter's account of the development of *Salmacis virgulata Alexandri* does not extend to metamorphosis. The present description of this tropical form is the first complete account. The temperature of the aquaria in which the larvæ were reared was maintained at 25°–26° C.

Soon after insemination, a fertilisation membrane is formed. Subsequent development is normal, a blastula being formed in eight hours and a gastrula in twenty-three hours. The first stage of development of the pluteus with the post-oral and antero-lateral arms is completed in three days. The development of the remaining two pairs of arms is complete by the twelfth day. The internal developmental processes have been followed and are essentially the same as those described for species of *Echinus*. It is interesting, however, that the amnion which marks the future oral surface commences to be formed even on the third day. The 10-day old larva of the Madras form resembles the 55-hour old larva of *S. virgulata Alexandri* described by Tennent. Evidently there is great disparity in the rate of development in spite

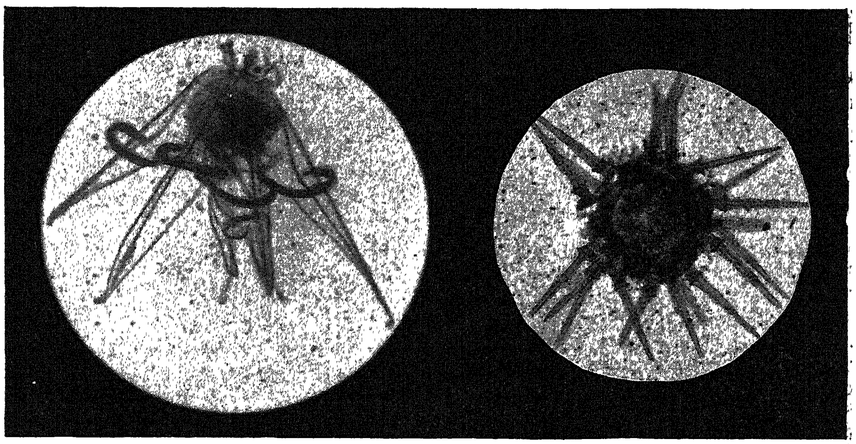

FIG. 1. *Salmacis bicolor*. Left hand, 14-day larva; right hand, urchin immediately after metamorphosis.

of uniformity in regard to temperature conditions, a fact which has already been noticed for other forms by Mortensen. During the twelfth day there is a broadening of the preoral and postero-dorsal arms. The anterior epaulettes are now formed, the posterior ones not being developed at all. The thirteenth day must be said to mark the completion of the development of the skeletal rods of the larva.

A single pedicellaria of the Ophiocephalous type appears on the fourteenth day and is soon followed by two more. A fourth appears very soon on the right side. Ear-shaped postero-lateral processes have developed. The larva sinks to the bottom, and the primary tentacles, pushing themselves into the base of the amniotic floor, soon break through. Metamorphosis is rapid and is usually complete by the twenty-fourth day. Quadrangular spines and ordinary spines, now smooth, have appeared and the young *Salmacis* creeps on the bottom. The adult mouth is a later formation. As yet there is only the first coil of the alimentary canal, soon to be completed by the formation of the second in a fortnight. In three months, when the young *Salmacis* is 4·5 mm. in diameter, the adult anus is formed as a crescentic slit. Six month-old urchins measuring 13 mm. were found to be immature.

The fact that mature individuals could be procured from Madras Harbour throughout the year seems to be in consonance with the view expressed by Semper[4] and Orton[5] that tropical marine animals breed continuously, though there are reasons to believe that *S. bicolor* exhibits an intensive period of reproductive activity during the rainy months.

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University of Madras.

[1] Mortensen, Th., "Studies of the Development and Larval Forms of Echinoderms". Copenhagen, 1921.
[2] Mortensen, Th., "Contributions to the study of the Development and Larval Forms of Echinoderms". *Mem. Acad. Roy. Sci.*, Copenhagen, 9, **4**, No. 1.
[3] Tennent, D. H., "Early Development and Larval Forms of three Echinoids of the Torres Straits Region", Tortugas Lab., Carnegie Inst., Wash., **26**; 1931.
[4] Semper, K., "Animal Life". London, 1883.
[5] Orton, J. H., "Sea Temperature, Breeding and Distribution in Marine Animals", *J. Mar. Biol. Assoc.*, **12**; 1922.

Thermal Decomposition of Acrolein

FROM measurements on the rate of decomposition of nitrous oxide and of several aldehydes, it has recently been suggested[1] that the same molecule may under different conditions of pressure decompose homogeneously in the same manner, but with different energies of activation. This is supposed to arise as a result of localisation of the energy of activation in different parts of the molecule. Similar considerations appear to be involved in the thermal decomposition of the rather more complex molecule acrolein, which proceeds homogeneously and at a convenient rate at temperatures in the region of 550° C. It has so far been studied manometrically over the range of initial pressure, 15–600 mm. The products of reaction are carbon monoxide and a mixture of hydrocarbons, the 'end-point' varying slightly with initial pressure.

If the reciprocal of the period of half-change (suitably corrected for the variation in end-point) is plotted against the pressure, a segmented plot is obtained consisting of three straight lines, each giving a positive intercept on the $t_{1/2}$ axis. These three independent 'bimolecular' regions occur over the approximate pressure ranges 15–40 mm., 40–200 mm., and 200–600 mm. It is probable that one or more such regions exists below 15 mm., and the same may be true at pressures higher than one atmosphere. The energy of activation, which is of the order 50,000 cal., is different in the several regions. The measurements are being extended over a wider range of pressure and temperature. The decomposition of propiolic aldehyde is also being studied.

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University Museum,
Oxford. Nov. 6.

[1] Hinshelwood, *Proc. Roy. Soc.*, A, **146**, 239, 327, 334, 345; 1934.

Cell Dimensions of Ordinary and 'Heavy' Ice

I HAVE recently made accurate determinations of the cell dimensions of crystals of ordinary and 'heavy' ice (D_2O). Single crystals were used. The apparatus consisted of a small Dewar flask mounted on the arcs of a Bernal photogoniometer, and filled with a mixture of acetone and solid carbon dioxide. A holder of copper wire attached to the bottom of the flask contained a capillary tube of Lindemann glass, into which a drop of water was sealed. The crystal was grown by inserting the glass tube into its holder in contact with the cooling mixture; its growth was observed with a polarising microscope, and it was thawed and grown again until a good single crystal was obtained. The direction of fastest growth was the normal to $(11\bar{2}0)$, so that this direction generally grew along the axis of the tube. There was a steep temperature gradient in the crystal; at the holder it was very nearly at −78° C., while its top, about 3·3 cm. above this, was at the melting point, and was in contact with a layer of liquid. The spacings could thus be determined at different temperatures.

Preliminary photographs showed that the structure of crystalline D_2O is the same as that of ordinary ice. The setting of the crystal was made by means of oscillation photographs. The exact spacings were determined from reflections at nearly 180°, recorded with a back-camera. For a, the plane $(50\bar{5}0)$ was used with copper $K\alpha$ radiation, for c, (0008) with cobalt $K\alpha$. The spacings were measured at −66° C. and at the melting-point. The results are given below, with an estimate of the probable limits of experimental error (values for D_2O at 0° C. are calculated from those at 4° C. by interpolation).

	Temp. °C.	Ordinary ice (H_2O) (A.)	'Heavy' ice (D_2O) (A.)	Probable limits of error (A.)
Base of cell, a	−66	4·5085	4·5055	± 0·002
	0	4·5135	4·5165	± 0·0014
	4	—	4·5175	± 0·0014
Height of cell, c	−66	7·338	7·338	± 0·0035
	0	7·3521	7·3537	± 0·0012
	4	—	7·3552	± 0·0012

The difference between the cell dimensions of the two crystals is thus extremely small. There seems to be a real difference between the a-dimensions at 0° C., but it is very small, certainly less than 0·1 per cent. It is possible to calculate roughly from the measurements the linear expansion coefficients parallel and perpendicular to the hexad axis. These are found to

be equal, within the limits of experimental error, and there is no significant difference between the coefficients of D_2O and H_2O. The mean value over the temperature range $-66°$ to $0°$ is 29×10^{-6} ($\pm 10 \times 10^{-6}$).

These results have a bearing on the structure of water. The ratio of the molecular volumes of crystalline D_2O and H_2O at 0°, calculated from the spacings, is 1·0014. The density[1] of D_2O at 25° gives a ratio for the molecular volumes at that temperature of 1·0034. Since the radius of the D_2O molecule probably does not increase much more rapidly with temperature than that of the H_2O molecule, the difference in the ratio of molecular volumes must be due to the structure[2] of the two liquids. The smaller volume per molecule indicates that H_2O approximates a little more nearly to an ordinary close-packed liquid; thus its average co-ordination number is a little greater than that of D_2O. In other words, D_2O has a more ice-like structure than H_2O at the same temperature. This conclusion is in agreement with the results of G. W. Stewart from X-ray diffraction measurements[3].

It is hoped to publish elsewhere further details of this work, of which the preliminary results have been reported previously[4]. H. D. MEGAW.

Department of Mineralogy
and Petrology,
Cambridge.
Nov. 1.

[1] H. S. Taylor and P. W. Selwood, *J. Amer. Chem. Soc.*, **56**, 998; 1934.
[2] J. D. Bernal and R. H. Fowler, *J. Chem. Phys.*, **1**, 515; 1933.
[3] G. W. Stewart, *J. Chem. Phys.*, **2**, 558; 1934.
[4] *Proc. Roy. Soc.*, **144**, 24; 1934.

Electrical Changes in the Cerebral Cortex

SOME recent newspaper articles have given sensational accounts of the investigations which we have made in Cambridge on the electrical changes taking place in the cerebral cortex. In these articles we are deeply concerned to find ourselves credited with the discovery of the rhythm which can be detected from the human brain by electrodes applied to the scalp.

This is an important discovery, but it was made six or more years ago by Prof. Hans Berger, director of the Psychiatric and Nerve Clinic at Jena, and has already formed the subject of eight papers by Prof. Berger. We have repeated and confirmed many of Berger's observations; our interpretation of the rhythm differs in some respects from his, but we wish to make it clear that our own work is of recent date and is in the main confirmatory, whereas Berger has already made a detailed study of the cortical rhythm in a very large number of cases and has shown the effect of mental work, external stimuli, sleep, drugs, etc.

We hope that a forthcoming paper by us in *Brain* will remove the impression that we are in any sense the discoverers of the Berger rhythm and of its modification by mental processes.

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BRYAN H. C. MATTHEWS.

Physiological Laboratory,
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Dec. 3.

Points from Foregoing Letters

THE value of heavy hydrogen as an indicator becomes daily more evident. Prof. Hevesy and Mr. E. Hofer, analysing the urine and water of transpiration of one of the experimenters who had drunk water containing excess of the heavy variety, find that a little of the heavy water appears in the urine within half an hour, but the bulk of the heavy water leaves the body slowly, about half being eliminated within nine days. The rate of elimination shows that water which is drunk becomes completely mixed with the whole water-content of the body.

A group of seven investigators in London and Berlin collaborating with several others have succeeded in producing neutrons by means of hard X-rays; the neutrons were then used for the synthesis of radio-bromine and radio-iodine, from compounds containing the corresponding elements. The production of neutrons by means of X-rays is an important step, since neutrons are more efficient than protons in atomic transmutation. Hitherto the only practical source of neutrons was an already existing radioactive element.

'Grinder' atmospherics, so objectionable to radio listeners, consist of a number of disconnected pulses, according to Mr. G. H. Munro and Dr. H. C. Webster, who have analysed the wave form with a cathode ray oscillograph. This composite nature accounts for the divergence in the views expressed by previous investigators concerning the duration of atmospherics.

Dr. J. S. McPetrie describes how the dielectric constant and the conductivity of materials at high frequencies can be determined from the decrease in wave-length in the given material, as compared with that in the air. The method has been used in the study of the electrical properties of soil.

Four generations of mice kept by Prof. R. B. Engelstad and Mr. N. H. Moxnes in a mine 350 m. deep where they were sheltered from cosmic rays, appear to be in no way different from 'control' mice kept at the surface, except that the 'sheltered' mice have a greater mean weight. It has been suggested that cosmic rays may be responsible for 'mutations', sudden changes in the characters of a species. The above experiments leave this question open.

The work of Mr. C. N. Hinshelwood and others indicates that certain substances (nitrous oxide, acetaldehyde) have excess energy differently located in some of their molecules. These molecules behave at different pressures as independent entities from the point of view of the velocity of chemical reaction. Dr. H. W. Thompson and Mr. J. J. Frewing have studied the decomposition of acrolein, the acrid substance formed when glycerine is heated, at various pressures, at 550° C.; it shows a similar behaviour.

Mr. H. D. Megaw reports that the crystalline structure of 'heavy' ice, containing heavy hydrogen, is the same as that of ordinary ice, the difference between the dimensions of the constituent molecular 'cells' being very small. His results further indicate that ordinary water has its molecules more closely packed than 'heavy' water, which has a more ice-like structure.

Research Items

Baptism and the Gypsies. While popular belief in a prophylactive element in religious ritual undoubtedly survived late, it is not always easy to find records of specific instances in which a semi-magical efficacy is attached to any one form of observance. It is, therefore, of interest to find a writer in the *Journal of the Gypsy Lore Society* (Third Series, **13**, pt. 4) directing attention to the excessive addiction to the rite of baptism of the gypsies at various periods of their contact with Christianity. In fact, in Saxony in the seventeenth century, it was found necessary to frame regulations for the institution of inquiry before the ceremony to check this abuse. Some are said to have had their children baptised nine and ten times; but in such cases, the motive appears to have been not superstition but gain, as on each occasion rich presents were obtained from the sponsors, who thought to acquire merit by standing for a pagan child. There is, however, a number of instances quoted, some going back to the end of the fifteenth century, from which it appears that while the gypsies cared nothing for religion, they were always anxious to get their children baptised in the belief that an unbaptised child was in a dangerous state. The Siebenburg gypsies, it is said, kindle a fire before the tent as soon as a child is born to keep evil spirits away, and extinguish it when the ceremony has made it unnecessary; and the Scottish border gypsies considered it unlucky to have an unbaptised child in a house. The magical effects of baptism were not confined to the child, but extended to any ornaments it wore. The Magdeburg church ordinances of 1652 forbade that children at baptism should be bedecked with corals, beads, gold and silver buttons and the like, in order that they too might acquire special power, though this is not attributed to the gypsies specifically, but "as common people say".

Prehistoric Pathology. A survey by Prof. A. V. Vallois of present knowledge relating to the pathology of prehistoric man, communicated to the Institut de Paléontologie humaine at the beginning of the current year, appears in *La Révue scientifique* (No. 20, Oct. 27, 1934). The general conclusion is that it is an error to suppose that our ancestors, living a wild and savage life, had acquired a greater resistance to disease than ourselves. There is, however, a difference in the diseases which were most prevalent, and this distinction is to be observed not only as between modern man and neolithic man, but also as between neolithic man and palæolithic man. Rachitis does not appear to be present in palæolithic man, but there is abundant evidence of rheumatoid arthritis, attacking the vertebræ as well as the limbs. It becomes increasingly common in the neolithic and bronze ages. Traumatic lesions are not very common in the palæolithic period. In the neolithic age they become more frequent and are found in all the bones. Two facts are noticed—the presence of flint arrowheads in the traumata, especially in the dorsal vertebræ, and the high proportion of cases in which the fracture heals with a good join. The observations of tuberculosis and syphilis are subject to the fact that no soft parts are available for examination; but otherwise there is no appearance of tuberculosis in the palæolithic period, while in the neolithic, bronze and iron ages cases are few. To a certain extent, there is uncertainty in the identification of the lesions of syphilis, but it would appear that there is no case of syphilis in palæolithic man, and in the later prehistoric periods only a very few cases from France and one from Russia appear certain. Dental caries is not found in palæolithic man in Europe, but appears in Africa in men of (probably) late palæolithic age. It is found for the first time in Europe in mesolithic man at Aveline's Hole (Somerset) and Teviec (Brittany).

Babylonian Mathematics. In the second edition (1934) of Prof. R. C. Archibald's pamphlet "Outline of the History of Mathematics" (now published by the Mathematical Association of America), there is an account of the discoveries of Otto Neugebauer, an Austrian scholar connected with the Mathematical Institute of the University of Copenhagen, concerning Babylonian mathematics. From about 3500 B.C. until 2000 B.C. the dominant race in Babylonia were the Sumerians. Among their achievements were engineering works, such as the draining of marshes and the construction of canals, and the adoption of cuneiform script. They were familiar with weights and measures, bills, receipts and accounts, and could calculate interest at various rates. Their arithmetic was essentially sexagesimal, and the same symbol may mean 1 or 60 or 3600, which is a source of great uncertainty in reading their tablets. Near the beginning of the Christian era they used a special symbol for zero. They knew a few results in geometry, but, like the Jews, took the circumference of a circle to be three times its diameter. Unlike the Greeks, the Babylonians discussed geometrical problems from what may be called an algebraical point of view; the steps taken seem to lead to simultaneous linear equations or even to quadratics. Cubic and biquadratic equations were dealt with, by means of tables which gave the squares and cubes of all integers from 1 to 60. It is remarkable that they accomplished all this without possessing any algebraical notation, or, as far as we can judge, any general theory underlying their particular problems. Moreover, their work seems to have been unknown, for at least 1800 years, to the Greek pioneers in the same subjects. There are still many cuneiform tablets not yet deciphered, and further discoveries are anticipated.

Hybrid Ducks. Two hybrid ducks, natural crosses between the hooded merganser (*Lophodytes*) and the American golden-eye (*Bucephala*) are fully described by Mr. Stanley C. Ball in Bulletin 3, Peabody Museum, Yale University. One was shot at New Haven in 1920. The only other known record is that of a specimen taken in Maine in 1854, and presented to the Boston Society of Natural History. These two birds show certain differences, the latter being immature. In general, their plumage and other characters are a mosaic of the parental characters, as in number of tail feathers, tarsal scalation, marking of tertials and scapulars. In size, colour of head and form of bill, they are intermediate, while in various other characters which are present only in one parent they appear in modified form in the hybrid. References are made to various other hybrid ducks.

New Congrid Eels. Two new eels belonging to the genera *Arisoma* and *Congrina*, and a new Pleuronectid, *Poecilopsetta albomarginata*, are described by Mr. Earl D. Reid in the reports on the collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep (Johnson Fund, *Smithsonian Misc. Coll.*, 91, No. 15; 1934). The author points out that tooth characters alone in classification of the congrid eels have very little value, since the variations are so extensive that intergradations are found throughout the group almost without exception. He states that the shape and position of the dental plates, spacing of the groups, and width of the bands of teeth seem to be the most reliable dental characters for purposes of generic distinction, and uses these in classifying the Congridæ discussed, dividing *Arisoma* from *Congrina* and its allies by the upper lip and its bone-like supports; in *Arisoma* the lip being turned upward into a flange, the bones of the facial canal do not send pointed processes into this flange; in *Congrina* the upper lip being without a flange, the bones of the facial canal send pointed processes to the edge of the lip. Examination of the material in the National Museum has revealed the presence of these labial elements, which were specially noted by Bleeker and Schmidt in *Uroconger*, in various degrees of development throughout the entire group of congrids. The pore-like slits in the lip in *Congrina* are shown to be vents of the muciferous channel, and not pocket-like pits for facilitating expansion of the labial membrane.

Life-history and Structure of the 'Cleg'. The common 'cleg', *Hæmatopota pluvialis* (family Tabanidæ), forms the subject of a paper by Dr. A. E. Cameron (*Trans. Roy. Soc. Edinburgh*, 57, Part 1, 1934). It appears that among 1,400 described species of Tabanidæ, only certain American and Indian species have been traced from the egg through all the larval instars to the adult. In studying the species in question, the author has provided the first complete account of the metamorphosis of a European species. It is noteworthy that the number of larval stadia varies from seven to nine or, in a few cases, to ten, and the species is univoltine or demivoltine. Observations are given on the mating behaviour, feeding and oviposition of the adult fly, and the methods of rearing the insect are described. A general description of the larval anatomy forms a large part of the paper, while the external characters of the pupa are also dealt with. Some account is given of the structure of the problematical organ known as Graber's organ and suggestions made as to its possible function. The paper contains 28 text-figures and a bibliography of the subject.

Respiration in *Ascaris*. Y. Toryu (*Sci. Reports Tôhoku Imp. Univ.*, 9; 1934) has examined the respiratory exchange of *Ascaris megalocephala*, which is not an obligate but a facultative anærobe. This worm produces carbon dioxide by a fermentative process in the absence of oxygen, but by an oxidative reaction in the presence of oxygen. When the worms are placed in Ringer's solution containing oxygen, they consume the oxygen until the tension in the medium becomes about 0·06. The total amount of carbon dioxide produced in 24 hours at 38° C. per 100 gm. of worms was from 80 c.c. (by females) to 200 c.c. (by males) in the presence of oxygen, and from 20 c.c. (by males) to 80 c.c. (by females) in the absence of oxygen. That little production of carbon dioxide or consumption of oxygen occurred during the first and the last few hours of the experiment suggests to the author that a true fermentation process took place.

Northern and Arctic Tunicata. The attention of workers on northern ascidians is directed to the fourth paper (*K. Svenska Vet. Akad. Handl.*, 3 Ser., 13, No. 3; 1934) by Augusta Ärnbäck-Christie-Linde, on the northern and arctic Tunicata in the Riksmuseum at Stockholm. The material of the northern Tunicata was obtained for the most part off the Bohuslän coast. The families included in this account are the Cionidæ, Ascidiidæ, Agnesiidæ and Rhodosomatidæ. Synoptic keys of these families and their thirteen genera and twenty-three species are given, and observations added on anatomical features and on the geographical and bathymetrical distribution.

Invert Sugar from the Cashew 'Apple'. In India the cashew, *Anacardium occidentale*, L., is largely cultivated for the nut, and the curious fleshy swelling of the axis beneath the nut is discarded. M. Srinivasan, of the Department of Biochemistry, Indian Institute of Science, has been exploring the possibility of utilising this fleshy 'apple' (*J. Indian Inst. Sci.*, 17A, Part 7). Alcohol could be obtained from its juice by fermentation, but the costs involved would not warrant large-scale production; on the other hand, the juice contains about 7 per cent invert sugar on the fresh weight of the apple and may easily find a use as a syrup. Pigments present in the juice render more simple its correct neutralisation by lime, and at neutralisation there is complete precipitation of albuminoids and tannins so that filtration is easy. The lime has then to be removed (as carbonate, sulphite or phosphate), before the juice is concentrated, when it yields a clear red syrup for which there may well be considerable demand, as invert sugar is in great use by confectioners. It may also serve as a useful source of lævulose, the sugar to which diabetic patients show so much tolerance.

Mechanism of Disease Resistance in Plants. Prof. W. Brown's presidential address to the British Mycological Society appears in vol. 19, Part 1 of the Society's *Transactions* ("Mechanism of Disease Resistance in Plants", pp. 11–33, Oct. 1934). The address is a valuable and exhaustive review of modern knowledge about the physiology of parasitism. Various types of parasitic attack upon plants are described, and then the mechanism of penetration of the fungus is discussed. Chemotropic theories are reviewed, and shown to be inadequate to explain all the observed facts. Entrance by contact stimulus is also an incomplete hypothesis. It becomes increasingly obvious that mechanical penetration of the host takes place in most plant diseases. Sources of energy for this process, and possible supplies of food, are discussed. Some results obtained by the author show that fungi vary greatly in their penetrative power, and suggest that thickness of cuticle on the host plant may be a factor in disease resistance. Internal mechanisms of resistance are also reviewed, from both mechanical and chemical points of view. Four types of chemical resistance are recognised: (1) The composition of the plant may be unsuited to the growth of a particular fungus; (2) the composition of the plant allows ready growth of the fungus, but not the production of toxic substances; (3) no fungal attack occurs, although chemical composition of the host allows good growth; (4) the active principle of the fungus is unable to affect

the tissues of the host plant. Well-defined examples of each type are given, and suggest wide possibilities for further research.

Meteorology of North-West India. The India Meteorological Department has published a small handbook dealing with the climate of the extreme north-west of India entitled "Meteorological Conditions affecting Aviation over the North-West Frontier" by Flight-Lieut. R. G. Veryard and A. K. Roy. Knowledge of the meteorological condition over the North-West Frontier has been derived largely from the records of the stations at Peshawar and Quetta, of several second- and third-class observatories, and of a number of rainfall stations. The region under review provides a considerable diversity of climates corresponding to the great differences in elevation; there are mountains which reach 26,620 ft. at Nanga Parbat in the Gilgit Agency, and low-lying plains bordering the Indus, that form part of one of the hottest areas in India. At Dera Ismail Khan, with an elevation of 590 ft., the mean daily maximum temperature exceeds 100° F. in the four months May–August and in June reaches 107·8° F., with a mean minimum of above 81° F. from June until August. Even at Fort Sandeman, with an elevation of 4,614 ft., a mean maximum of 100° F. is attained in June and July. Apart from the climatological tables there is a general discussion of all the meteorological elements over the whole frontier region, and detailed discussions of different parts of that region, and in these the year is divided into two main seasons, the hot and the cold, and two transitional periods. In the cold season (December to mid-April), depressions pass directly across the frontier to the plains of north-west India; there are about five or six to each month, and they cause changes in the weather of the kind usually associated with temperate depressions. In the succeeding transitional period that extends to about the end of June, the depressions follow more northerly tracks and generally give rise only to local convectional rains. From July until September there are intermittent incursions of the monsoon, either directly from the Arabian Sea or indirectly across Northern India from the Bay of Bengal, and thereafter the second transitional period corresponding with the reappearance of eastward-moving depressions to the north of the frontier.

Formation of Emulsions. Prof. G. I. Taylor (*Proc. Roy. Soc.*, A., Oct. 1) has investigated the distortion and disruption of drops of fluid suspended in another fluid which has a non-uniform but mathematically definable field of flow. The breaking of the drops results finally in the formation of an emulsion. Drops of an oily mixture were suspended in a tank of golden syrup which was stirred by two parallel bands moving in opposite directions or by four rollers, the latter arrangement giving approximately hyperbolic lines of flow. The distortion of the drop at low speeds of flow was in agreement with a theoretical formula, but at higher speeds the shape of the drop varies with time. The ultimate fate of the drop depends very much on the ratio of the viscosities of the two fluids. When the viscosity of the drop is very small compared with that of the syrup, the drop elongates very greatly but does not burst; for higher viscosities of the drop, the drop elongates to a threadlike form and breaks up into droplets about one hundredth of the size of the original drop. For very viscous drops the parallel field of flow is no longer able to produce disruption.

Nuclear Disintegration Experiments with Pure Isotopes. M. L. Oliphant, E. S. Shire and B. M. Crowther have recently described the separation of the pure lithium isotopes and their nuclear reactions under bombardment with protons and heavy hydrogen ions (*Proc. Roy. Soc.*, A, Oct. 15). The isotopes were separated in a simple mass-spectrograph; ions obtained from a filament coated with a lithium mixture were accelerated into crossed electric and magnetic fields so disposed that the selected ions travelled in a nearly straight path. In one form of the instrument, electrostatic fields were used as 'focusing lenses'. The films of isotope were deposited on metal collectors cooled with liquid air. The quantities separated were of the order of 5×10^{-8} gm., the time of collection being about an hour for the less common Li^6 isotope. The specimens obtained were bombarded with ions of about 160,000 volts. Li^6 yielded with proton bombardment α-particles of 11·5 mm. range, probably obtained by the reaction:

$$_3Li^6 + {_1H^1} \rightarrow {_4Be^7} \rightarrow {_2He^1} + {_2He^3};$$

the He^3 particles being those observed in the present experiments. With H^2 bombardment, there was a large emission of α-particles of 13·2 cm. range:

$$_3Li^6 + {_1H^2} \rightarrow {_4Be^8} \rightarrow {_2He^4} + {_2He^4};$$

and of 30 cm. range protons:

$$_3Li^6 + {_1H^2} \rightarrow {_4Be^8} \rightarrow {_3Li^7} + {_1H^1};$$

Li^7 yielded 8·4 cm. range α-particles with protons:

$$_3Li^7 + {_1H^1} \rightarrow {_4Be^8} \rightarrow {_2He^4} + {_2He^4};$$

and with diplons a continuous spectrum of α-particles

$$_3Li^7 + {_1H^2} \rightarrow {_4Be^9} \rightarrow {_2He^4} + {_2He^4} + {n_0}^1;$$

the neutron emission being also observed. The nuclear reaction showed that the contamination of the isotopic specimens with the unwanted isotope was very small and in the worst cases of the order 1 per cent.

Origin of the Craters on the Moon. F. Leitich of Vienna has recently discussed the unsolved problem of the origin of the lunar craters, with particular reference to the outstanding example Copernicus (*Astro. Nach.*, 253, No. 6065, Oct. 1934). He considers and rejects the explanation, which has been suggested, that they are due to the impact of meteors, and concludes that they result from causes within the moon. In great detail he develops a new hypothesis, that they are due to volcanic action, but of a kind very different from that which, by the emission of lava, has formed craters upon the earth. In his view, the typical lunar crater was made by an outbreak of volcanic gases, slowly accumulating, through thousands of years, between the surface of the moon's crust and an overlying layer, some kilometres thick, of salts (chiefly chlorides of sodium, potassium, calcium, etc.). This outer layer is supposed to be very light, being cellular in structure, owing to the presence of much gas within it when it was formed. This light but strong layer is supposed to have become raised like a (very slightly arched) dome over the growing volume of gas beneath, until finally a collapse occurred. The author explains how this could give rise to the central peak, the mountain-walled plain, and the radial ridges beyond. He suggests that the condition of the disrupted borders of the craters may give an indication of the relative ages of the different craters.

Anniversary Meeting of the Royal Society

THE annual meeting of the Royal Society was held on St. Andrew's Day, November 30, when the president, Sir Frederick Gowland Hopkins, delivered the anniversary address. He referred to the Society's loss by death during the past year of one foreign member and twenty-two fellows. Speaking of the Council's report, he pointed out that the capital value of the Society's research funds now exceeds £600,000, the income from which is £23,700. During the year, a little more than £25,000 was spent in support of research. In spite of this expenditure, Sir Frederick stated that it had proved difficult to meet the many requests for financial support for research in the field, which is now becoming an urgent need in many branches of science. The Treasury was unable to give an additional grant for this purpose, so some of the Society's research funds were utilised. Field research of great scientific and economic importance is inadequately supported at the present time, and the Royal Society is a suitable trustee for any funds which may be provided. Sir Frederick then passed on to a discussion of the parts which the clinician and the laboratory workers play in the development of fundamental medical knowledge.

At the conclusion of his presidential address, Sir Frederick presented the medals for 1934; extracts from his remarks in making the presentations are printed below.

Presentation of Medals

COPLEY MEDAL, awarded to PROF. J. S. HALDANE

Prof. HALDANE is awarded the Copley Medal for discoveries in physiology and their application to a number of important problems, practical and industrial, in which the human factor is evolved. Haldane's researches in physiology centre on that of respiration. His work on the chemical regulation of breathing first made clear the delicacy of correlation on which depends the power of an animal to adapt itself so widely to environment, or to bodily activity. While this work has greatly affected the outlook of physiologists, and has had a fundamental influence on medicine, it has led also to applications of the greatest value, not only in science and medicine but also in everyday life. His investigation of the causes of death in colliery explosions led him to his researches on the union of hæmoglobin with oxygen and carbon monoxide, thence to his discovery of the action of light on the equilibrium between these substances, a discovery which has played a fundamental rôle in the investigation of others. His interest in the influence of high underground temperatures on the working capacity of miners led him to an exhaustive study of the regulation of bodily temperature and of the function of the sweat glands. His 'stage decompression', based on a bold and simple application of gas laws to the human body, gives him a similar claim to the gratitude of divers, or of workers in compressed air, who are liable to caisson disease.

The most striking characteristic of Haldane's work is the way in which his great experimental skill, based always on the simplest methods, and his strong philosophical instincts, have reacted with the broad humanity of his outlook and with the courageous use of his own person, when necessary, for the more drastic observations. Haldane's researches have influenced such diverse activities as mining, diving, flying, muscular work, mountaineering, protection against gas; and his teaching has left a permanent mark on physiological thought.

RUMFORD MEDAL, awarded to PROF. W. J. DE HAAS

One of the main pieces of work that brought fame to de Haas was on the Einstein – de Haas effect, the measurement of which constitutes the first experimental proof of the spin of the electron. In association with a series of collaborators he has made an extended study of the magnetic susceptibilities of various diamagnetic solids in the single-crystalline as well as in the poly-crystalline form. These studies revealed a dependence of the magnetic susceptibilities on the strength of the magnetic fields used and also on the temperatures at which the measurements were made. Similar studies were made by de Haas of the electrical resistance changes undergone by diamagnetic substances under the influences of magnetic fields of various strengths. High diamagnetism and strong resistance changes were found by him to go together. In 1917 he showed that these phenomena could be explained quite readily by the classical theory of light.

In recent years de Haas has done an enormous amount of work on the supra-conducting properties of metals. In particular he has studied exhaustively the effect of magnetic fields on supra-conductors. This is most valuable and the results are likely to lead to very important developments in the theory of electric conduction in metals at low temperatures. Recently de Haas has succeeded in reaching the lowest temperature as yet attained. It was done through the use of a cooling effect obtained by the adiabatic demagnetisation of paramagnetic salts. His latest achievement in this field is to reach a temperature of $0 \cdot 031°$ K. in a volume of $\cdot 56$ c.c. of potassium chrome alum through demagnetising the salt when it was thermally insulated.

A ROYAL MEDAL, awarded to PROF. S. CHAPMAN

Prof. Chapman has made contributions of the highest importance to the kinetic theory of gases. In the original researches of Clerk Maxwell, an artificial assumption as to the law of attractive force between the molecules was introduced for the purpose of simplifying the mathematical analysis. Chapman has worked out a generalised theory which assumes no properties for the molecules other than spherical symmetry, and has derived formulæ for the viscosity, diffusivity and conductivity of a gas.

Much of Chapman's work has been concerned with terrestrial magnetism. He has outlined a theory of magnetic storms, and discussed the energy of such storms and the inferences as to the electric and magnetic state of the interior of the earth which can be deduced from terrestrial magnetic variation. He has developed a general theory of the diurnal variations in the earth's magnetism produced by the moon and sun. Somewhat parallel to these investigations have been investigations of the general magnetic field of the sun and of its radial limitations; of solar ultra-violet radiation as a cause of auroræ and magnetic storms, of the influence of solar eclipses on the ionisation of the upper atmosphere and the study of the properties of solar streams of corpuscles. The composition, ionisation and viscosity

of the atmosphere at great heights and a theory of upper atmospheric ozone are some of the other problems to which Chapman has devoted his attention.

A ROYAL MEDAL, awarded to PROF. E. D. ADRIAN

Prof. Adrian is distinguished for his work on the physiology of the nervous system. He has dealt with the activities of the single nerve fibres, single sensory end organs, single muscle fibres, and single nerve cells of which neuro-muscular function is built up, and in each of these he has found one simple quantitative factor in the physiology of sensation or response, namely, the frequency of the rhythmic electrical disturbances which occur in it. Increased intensity of stimulus to a sensory organ means increased frequency of impulses arising from it; increased response from a muscle fibre means increased frequency of stimulation. Recently he has studied the electrical changes of the cortex of the brain, and with Matthews has shown how, even in conscious man, objective graphic records can be made of the rapid electrical accompaniments of various cerebral states. In earlier work he dealt with the complex effect of light on the retina. Equally he has exhibited and made objective factors in the bodily use of the nerve impulse, which Sherrington recognised, but of which he could obtain only indirect evidence.

DAVY MEDAL, awarded to PROF. W. N. HAWORTH

Prof. Haworth is distinguished for his researches on the molecular structure of the carbohydrates. He established, in collaboration with E. L. Hirst, the six-membered oxide ring constitution of the normal simple glycosides, a formulation which is now universally accepted as correct. Following this up, he showed that the more labile so-called γ-glycosides contain a five-membered ring, and he has surveyed the wide field of the saccharides, allotting on experimental grounds a pyranose or a furanose structure to the varied members of the series. Further, he has successfully attacked the problem of the full constitution of disaccharides and even of polysaccharides, and has been able to present a picture of the relations of an entire group of natural products as complete and as satisfying as any in the organic chemist's gallery. His work has a characteristic quality of conclusiveness, due in large measure to a wise insistence on the importance of the use of crystalline reference compounds. In this and other connexions he has made notable advances in the appropriate experimental technique.

DARWIN MEDAL, awarded to PROF. A. C. SEWARD

Prof. Seward has taken a very important part in the great revival of interest in fossil plants which commenced towards the end of last century and has provided such a weight of direct evidence for the doctrine of evolution. Of his larger works, the British Museum catalogues of Jurassic and Wealden plants have been invaluable to subsequent investigators of these floras, while the great textbook on fossil plants, published during a period of twenty-one years, has made the wide fields of palæobotany easily accessible to all botanists. An admirable summary of our knowledge of the past history of vegetation, of its distribution throughout the world and of its bearings on the problems of fossil climates and palæogeography is contained in his book "Plant Life through the Ages". In this the fossils are seen as living plants in a real world and the knowledge of them is applied as the key to the significance of the distribution and composition of the flora of the present.

More than a hundred memoirs dealing with detailed studies of collections and individual plants have appeared from his pen. Among them his studies on the fossil floras of the southern hemisphere and of the old continent of Gondwanaland must be specially mentioned. His botanical and geological contributions to problems of palæoclimatology give not only the fruits of mature thought, but also the mass of data collected is of permanent value for all future investigators. These studies also are of great importance in connexion with the theory of natural selection.

SYLVESTER MEDAL, awarded to EARL RUSSELL

The name of Bertrand, Earl Russell, is proposed for the Sylvester Medal, in recognition of his researches on the foundations of mathematics. His earlier writings, the "Essay on the Foundations of Geometry" (1897) and the "Principles of Mathematics" (1903), in the latter of which the attempt was made to reduce all pure mathematics to symbolic logic, led up to the great undertaking (originally planned as a second volume of the "Principles") of the "Principia Mathematica", the first volume of which (written in collaboration with Prof. A. N. Whitehead) appeared in 1910 and two further volumes later. This, the most important work of the 'logistic' school (as distinguished from the 'axiomatic' school led by Hilbert, and the 'intuitionist' school led by Brouwer), is written in a symbolism originally devised by Peano and greatly extended by Russell. Most of the original researches published since 1914 by members of the logistic school have taken the "Principia" as their point of departure.

HUGHES MEDAL, awarded to PROF. K. M. G. SIEGBAHN

Siegbahn began his research work in the field of electro-magnetic waves and published a series of theoretical papers on the transmission of electrical disturbances along cables, and on related electromagnetic problems. Since 1914 most of his research work has been devoted to X-ray physics, especially to X-ray spectroscopy. With the view of bridging the gap between the X-ray and the optical spectra, the method with ruled gratings at grazing incidence was made the subject of a thorough investigation by him. In connexion therewith, two ruling machines of new design were constructed by Siegbahn at Uppsala. Gratings ruled on these machines have been successfully used by him and his co-workers for exploring the unknown region of X-ray spectra (20–500 A.). He has succeeded in registering and measuring a large number of X-ray series, including the N- and O-series in this region. This work is now in progress and is being pressed forward vigorously. Prof. Siegbahn's gratings, though small, are among the finest ever ruled. In addition to his work on long-wave X-rays, Prof. Siegbahn is also at present laying the foundations for an exploration of the spectral region between short radio waves and infra-red radiation.

One of the most outstanding pieces of work carried out by Prof. Siegbahn and his co-workers includes their beautiful demonstrations of reflection, refraction, interference, and diffraction phenomena with X-rays.

Importance of Grassland in New Zealand

LORD BLEDISLOE'S tenure of office as Governor-General of New Zealand has assuredly had a significance that will come to be regarded as of great historical interest. Because he is himself an expert agriculturist, and a pioneer in the movement which led to the establishment of a co-ordinated system of agricultural research in Great Britain and throughout the Empire, he has been able to take an informed and truly helpful interest in the Dominion's leading industry—agriculture.

From time to time, Lord Bledisloe has delivered a number of addresses—addresses of a practical and technical nature—to the farmers of the Dominion. In all these addresses, the great importance of research has been emphasised and the results of investigations conducted in Great Britain and in all parts of the world brought to the notice of his audiences.

In his most recent address, when opening the Third Conference of the New Zealand Grassland Association at Palmerston North, on October 2, Lord Bledisloe most appropriately has taken grassland as his subject*. New Zealand stands in a unique position relative to her sources of wealth. They are based to an overwhelming extent on her grasslands and on her exports to Great Britain. Grassland products form 94 per cent of her total exports—while 70 per cent of her exports cannot at present be marketed elsewhere than in Great Britain.

In the changing world of to-day, these two facts present very difficult problems for solution at the hands of both the Dominion herself and of Great Britain. New Zealand could easily increase vastly the amount of her grassland products—Lord Bledisloe has no difficulty in making this abundantly clear—but relatively speaking, Great Britain could undoubtedly do the same to an even greater extent. This is epitomatic of the economic tangle in which the whole world is engulfed. Lord Bledisloe in his address is, however, concerned not with world problems, not with the grasslands of the world, but explicitly with the grasslands of New Zealand. He perhaps places the advantages which New Zealand possesses in the matter of a perfect balance between sun and shower rather too high, when he gives it as his opinion that the potential output of meat and milk from the sown pastures of New Zealand would be at an average per acre of 60 per cent above that of Great Britain—always above, emphatically, but not 60 per cent above what the sown pastures of Britain could be made to be.

With great justice, Lord Bledisloe urges the New Zealand farmers to give more attention to the production of supplementary crops—silage and fodder crops for winter feed. He also considers that the Dominion would be well advised to extend the scope of her products for export; and remarks ". . . there is in this Dominion an urgent need for more diversified farming based upon the current requirements, within saturation limits, of overseas markets". He points to the part which the pig may be made to play in connexion with the small dairy farm; and it is certainly remarkable that the New Zealand dairy industry has been built up without any supplementary aid from concomitant swine husbandry.

Lord Bledisloe considers that the dairy farmers should pay a great deal more attention to cheese, and especially to the quality of the cheese produced. In this connexion, he emphasises the important fact that what is a good pasture for other livestock products is not necessarily a good pasture for cheese production, and incidentally directs attention to a matter, the *ad hoc* uses to which pastures are put, which has nowhere been made the subject of sufficiently critical investigation.

Lord Bledisloe concludes his address with an admirable summary of recent grassland research, and emphasises the strides New Zealand is making by means of schemes of certification applied to her grassland seeds. There is not the least doubt that certified New Zealand white clover and Akaroa cocksfoot have a very considerable usefulness in Great Britain. It must not, however, be thought that the Hawke's Bay rye-grass for our purposes can be placed in the same category as seed taken from genuine old Kentish pastures, even if 'somewhat inferior' to our authenticated strains. The Hawke's Bay rye-grass in Britain behaves more like 'commercial' than like 'indigenous' strains. It is, however, more permanent than the commercial and therefore, as Lord Bledisloe remarks, superior to it for long leys—but for such long leys (as equally for permanent pasture) the genuine Kentish rye-grass is in a class to itself.

* Grassland: the Main Source of the Nation's True Wealth. By Lord Bledisloe. Pp. 36. (Auckland, N.Z.: Gordon and Gotch (A'sia), Ltd., 1934.) 9*d*.

Early Science in Oxford

THE appointment of a reader in the history of science at Oxford is a notable event, and the inaugural lecture of Dr. R. T. Gunther, the first holder of the post, contains much interesting information not generally known*. It deserves careful study, and may, it is to be hoped, arouse the interest of the University of Oxford to a consciousness of what has already been done by Oxford towards the promotion of science, and what it might do in the special but philosophical field of the history of science.

Roger Bacon studied in Oxford; the earlier meetings of the Royal Society took place in Oxford, in Wadham College in the time of Wallis; Christopher Wren was a Wadham man and Savilian professor of astronomy; Rigaud, another Savilian professor, was one of the first historians of science, and Oxford has now appointed the first reader in the subject. Dr. Gunther is a Magdalen man, and he tells in his lecture a good deal about the work and collections of Dr. Daubeny, another Magdalen man, made a fellow of the Royal Society in 1822. Considering what Dr. Gunther has done, in pious memory and scientific sequence to Dr. Daubeny, considering too that Dr. Charles Singer, a leading historian of science, is also from Magdalen, that famous and opulent foundation may fairly take its place by the side of Wadham on the rôle of Oxford science.

* Oxford and the History of Science: with an Appendix on Scientific Collections in College Libraries. Dr. R. T. Gunther. Pp. 49. (London: Oxford University Press, 1934.) 2*s*. net.

Dr. Gunther describes in his lecture both the collections of books and geological material left by Daubeny and of which he took charge, and also how for many years he continued the scientific work of Daubeny in measuring the sea- and land-levels all round the Italian coast. Daubeny, though a man of varied scientific interests, had made a special study of volcanic phenomena in Europe, above all in France and Italy. He represented the universities of England at the first meeting of the British Association at York in 1831, and through his influence the second meeting was held in Oxford.

Dr. Gunther has done well to keep Daubeny's memory alive in his old university, and the opportunity now seems to have arrived to give better housing, both for the Daubeny collections and library and also for the Lewis Evans collection of scientific instruments which have been left to Oxford, and are at present exhibited in a portion of the Old Ashmolean building. It is difficult for a non-resident to appreciate all the conditions of building in present-day Oxford. We know that the Bodleian is now embarking on a large scheme of reconstruction. It is known also that the Radcliffe Trustees have recently opened a new and beautiful building. There is also, it seems, additional accommodation available in the Ashmolean for the objects which Dr. Gunther desires to preserve.

The building question is therefore complicated, but every friend of science will heartily support Dr. Gunther in his claim that the history of science should be duly represented in the university which has so many men of science on its rolls. An obvious and indispensable way of doing this is to have a good library of books on this branch of knowledge, available for all serious students. If this can be done in conjunction with a museum of scientific instruments and objects, such as those which Dr. Gunther has in charge, it would, of course, have added value.

Electrical Warming of Large Buildings

IN a lengthy paper read to the Institution of Electrical Engineers on December 6, Mr. R. Grierson and Mr. D. Betts make a critical examination of the present practice relating to electrical warming, air-conditioning and hot water supply to large buildings.

It is often assumed that before electric heating can be justified as compared with a coke-fired boiler and hot water or steam radiators, electricity must be sold at 0·1*d.* per kilowatt hour. The assumption is made, that so long as 0·1*d.* purchases 3,410 British Thermal Units either from some form of electric radiator or from hot pipes, it is of equal value to the consumer. No account is taken of the practical elimination of the labour, dust and dirt effected by the electrical method. The fact also is disregarded that the householder has to pay 37*s.* 6*d.*–75*s.* per ton of coal in the London area, whereas the fuel clause in the contracts of the Central Electricity Board are based on prices lying between 13*s.* and 18*s.* a ton. It is only necessary to recall the wonderful visibility of the atmosphere prevailing during the general strike of 1926 to see what a boon it would be to city dwellers if the volume of combustion products from chimneys were diminished.

It is now generally recognised that the question of the heat insulation of buildings is of great importance, and so slab cork and slag wool are being used to diminish the heat leakage. Thermostatic control is now largely used to prevent rooms from being overheated. Although the thermostat is a very trustworthy device, it is the standard practice in heating installations where the water is heated electrically to provide two instruments in series. One of them, the control thermostat, operates at the normal maximum temperature, while the other, called the safety thermostat, is set several degrees higher. A margin of 20° F. below the boiling point of water is set for the control instrument and 10° F. below boiling point for the other. Luckily, the 'ageing' of thermostats is in the direction of lowering the operating point.

The universal use of filtering plant for the continuous purification of swimming pools, instead of changing the water twice a week, has greatly simplified the heating problem. Formerly, the problem was to warm very large quantities of water in the least possible time; now it is merely to prevent the water from cooling.

Air-conditioning plant has now been greatly improved. The air enters the room at a given temperature and humidity and the vitiated air is extracted. The minimum standard adopted by the London County Council is 1,000 cubic feet of fresh air per hour per person for music and dance halls. In winter, this amount is quite satisfactory; but in summer the temperature rises too high and so the fans are driven at a higher speed, often giving more than 2,000 cubic feet of air per hour per person. For cooling, powerful refrigerating plant is sometimes used. A 265 h.p. motor is installed for this purpose at the Masonic Peace Memorial Building in London.

University and Educational Intelligence

CAMBRIDGE.—The Arnold Gerstenberg studentship, founded in 1892 by Mrs. Leonora Phillips in memory of her brother Arnold Gerstenberg with the object of promoting the study of moral philosophy and metaphysics among students of natural science both men and women, has been awarded to R. C. Oldfield, of Peterhouse.

F. Goldby, of Queens' College, has been appointed University lecturer in anatomy, and H. W. Hull University demonstrator in anatomy.

Applications are invited for the Gwynaeth Pretty studentship for research in the etiology, pathology and treatment of disease. It is of the annual value of £200. Applications should reach Prof. H. R. Dean, Department of Pathology, before February 1.

OXFORD.—On December 1, Dr. R. T. Gunther continued his series of public lectures on the history of science in Oxford by a discourse delivered at Corpus Christi College. Remarking that the contribution to natural science by members of that College made up in quality what was lacking in quantity, he directed special attention to Nicholas Kratzer, who became a fellow of the College in 1517, the year of its foundation. In Kratzer's hands the development took place of the mural and pedestal sundial to such portable dials as the polyhedral timepiece made by him for Cardinal Wolsey, by whom he was constituted mathematical reader in the University. Thomas Hornsby, who succeeded Bradley as Savilian professor in 1762, was mainly

instrumental in the establishment of the Radcliffe Observatory. His own observations, which have only recently (1932) been properly reduced and published, by Drs. Rambaut, Knox Shaw, Jackson and others, are extraordinarily accurate. The famous Dean Buckland, who was admitted to the College in 1801, remained there until he became Canon of Christ Church in 1825. His palæontological collection was originally housed at Corpus Christi College.

THE RIGHT HON. WALTER ELLIOT will deliver the foundation oration at Birkbeck College, Fetter Lane, London, E.C.4 at 8.15 on Wednesday, December 12, when the one hundred and eleventh anniversary of the College will be celebrated. No tickets are required.

THE Commonwealth Fund of New York is offering twenty-eight Commonwealth fellowships in 1935, tenable by British subjects in American universities. Each fellowship is of the approximate value of 3,000 dollars annually. Tenure of a fellowship usually involves an absence from Great Britain of about 22 months, though a fellowship may be extended for a third year. Further information can be obtained from the Secretary, Commonwealth Fund Fellowships, 35 Portman Square, London, W.1.

SPECIAL education in Uruguay is surveyed by Sr. Emilio Verdesio in a monograph of some 260 pages recently published by the Department of Public Instruction in that country as No. 1 of vol. 35 of *Annals of Primary Education*. This study, which is fully documented and illustrated with numerous photographs, has been published with the view of distribution wherever the case of defective or otherwise abnormal children is made a subject of scientific investigation. It describes open-air, seaside and riverside schools, schools for crippled and rachitic children, institutions for the deaf and blind, classes for children suffering from speech impediments, classes for backward children, auxiliary schools for the mentally deficient and "Escuelas Hogares" for problem children.

THE twenty-third annual Conference of Educational Associations will be held at University College, Gower Street, London, W.C.1, on December 31–January 7, under the presidency of the Marquess of Lothian. The presidential address, entitled "Liberty and Collectivism", will be delivered on December 31. On January 2, a joint conference on "Education for Leisure" will be delivered, when the principal speakers will be the Hon. Mrs. Franklin, Mr. Gerald Heard and Mr. A. C. Richmond. On January 5, a conference on educational and vocational guidance methods will be held at the National Institute of Industrial Psychology, to which members of the Conference of Educational Associations who are actually working in this field are invited. Among the subjects of discussions to be held at the Conference at Gower Street are the following, together with the principal speakers :—"Biology and General Science in the First School Examination" (J. K. King, J. Line and W. Sumner) ; "Zoos in their Educational Aspect" (Prof. Julian Huxley) ; "Psychology and Religion of the Future" (The Very Rev. the Dean of St. Paul's). Among the lectures to be delivered are : "The Objects, Value, and Methods of International Teaching in the Schools in Terms of the New World Situation" (Dr. Delisle Burns) ; "The All-Importance of the Study of Habits for the Knowledge of Evolution" (Prof. E. W. MacBride) ; "Some Reflections on the Scottish Mental Survey" (Prof. James Drever). Further information can be obtained from the Secretary, 29, Gordon Square, W.C.1.

Science News a Century Ago

J. D. Forbes and Airy

Forbes was always an indefatigable correspondent, and his "Life and Letters", published in 1873, contain many of his letters. He was the first to introduce the study of the undulatory theory of light in Scotland and on December 11, 1834, he wrote to Airy: "I have at length found leizure to read with great attention, and consequently with very great pleasure your undulatory tract, which quite fulfils my expectation as to the nature and extent of the evidence on this marvellous subject. I have been getting sundry pieces of apparatus made, and can now profit by your valuable practical lessons, as well as by the papers with which you have from time to time favoured me, and which I am now better prepared to appreciate." In the same letter he referred to the experiments on heat which he had mentioned to Quetelet about a week before. "I have lately," he said, "succeeded in establishing, as I think for the first time demonstratively and quantitatively, the polarization of non-luminous heat. I abandoned the method of reflection, which is the only one hitherto employed, and adopted that of transmission through piles of thin mica plates, for which the Thermo-multiplier is well adapted, and with entire success. I have also been endeavouring to determine numerically the refrangibility of non-luminous heat. I discovered, what I now find that Melloni had previously done, that the tourmaline transmits almost as much heat when two pieces are placed with their axes crossed as when parallel. Melloni saw quite as much as I also at first found, but I afterwards detected a slight difference."

Geological Survey of the United States

"We announce with great satisfaction a most important act of legislation by the Congress of the United States, the authorization of a geological survey of that fine country so rich in minerals and geological phenomena. It gives us pleasure also to add that President Jackson has committed the execution of this arduous undertaking to Mr. Featherstonhaugh, one of the members of the Geological Society of London [F.R.S., 1835] who has acquired deserved reputation as a practical and ardent geologist. This gentleman has been many years a resident of the United States, and it is of him that Mr. Conybeare says that he is eminently qualified, from his intimate acquaintance with European formations, to advance those comparative views which demand the principal attention in our science. We cannot but look with unmixed admiration upon the steadyness with which all the great interests of the United States are pursued ; the States have wisely concurred in a great act of legislation that cannot but redound to the best interests of their country and the substantial advancement of natural science. It is an act that Europe will admire, and that will ever reflect great honour upon the administration of the present distinguished chief magistrate of the United States." (*Phil. Mag.*, Dec. 1834, Editorial Note.)

Societies and Academies

DUBLIN

Royal Irish Academy, November 12. R. LLOYD PRAEGER: A contribution to the flora of Ireland. The paper is in part a third supplement to "Irish Topographical Botany", bringing knowledge of Irish plant distribution up to the present date, and partly an expansion of the same work, the old conservative concept of a species being replaced by that adopted in the "London Catalogue of British Plants", eleventh edition, and the distribution of the plants being shown according to the latter standard. J. M. O'CONNOR, M. MORIARTY and O. FITZGERALD: The physiological basis of the sensation of cold. The excitability of the skin in response to cold stimuli is influenced by its initial temperature. While rising in general with rising temperature, it falls sharply at about 29°, 35° and above 38°. These alterations in excitability can be explained by the stimulus to the skin being not merely the fall in temperature but also the fall in a physiological activity. This activity occurs in three phases following, so far as they can be examined, the Arrhenius equation, with different values of the constant μ. Paradoxical sensations are produced at the transition points. The amounts of oxygen used by the anæsthetised rabbit as a result of shivering plotted against skin temperatures correspond with the first two phases of the excitability of the human skin. The oxygen consumption of the rabbit in which shivering does not occur, or is suppressed by curare, is influenced by temperature in three phases corresponding, so far as comparison is possible, with the activity phases of the skin. The bearing of the results on the regulation of the body temperature is discussed. A. FRAZER-BRUNNER: New or rare fishes from the Irish Atlantic slope. A report on the more noteworthy fishes taken by the author during a cruise on a commercial steam trawler in the neighbourhood of the Porcupine Bank over depths of 100–300 fathoms. Fine meshed mid-water nets were fished while the vessel was drifting and yielded a number of interesting forms. Four new species were described, *Nematomurus farrani*, taken in the trawl, and *Dolopichthys inimicus*, *D. hibernicus* and *Gigantactis filibulbosus*, taken in the midwater nets, the last three being only represented by immature specimens. The types of the new species have been deposited in the British Museum. J. N. HALBERT: A list of Irish Hemiptera (Heteroptera, Cicadina). On comparison with the fauna of Great Britain, the Hemiptera show a disparity in numbers of species similar to what is known to occur in other groups of insects. The heteropterous section is now comparatively well known, comprising about 253 species, as against 485 in the British Isles. Information on the Homoptera is still scanty, only 156 species having been found in Ireland. While there are no endemic species, and certain families such as the Pentatomidae are poorly represented, several rare and interesting species occur including both northern and southern forms. There are a few species of south-west European origin and these are found in the south-east of Ireland, where the drier conditions may have been the deciding factor in their local distribution.

PARIS

Academy of Sciences, November 12 (*C.R.*, 199, 989–1076). The president announced the death of Admiral Fournier. CHARLES CAMICHEL and LÉOPOLD ESCANDE: Contribution to the study of reduced models of erosion by water. HENRI JUMELLE: The Plectaneia, Apocynaceæ of Madagascar. Descriptions and locations of eleven species. ALBERT CAQUOT was elected a member of the Section of Mechanics in succession to the late P. Vieille. J. DIEUDONNÉ: A problem of the theory of polynomials. GEORGES GIRAUD: Partial differential equations, linear or non-linear, of the elliptic type. ADOLPHE BUHL: Certain Monge-Ampère equations of which the integral surfaces produce certain invariant integrals. J. R. BRAÏTZEFF: The course of the function defined by a Dirichlet series in the neighbourhood of a singular point. MAURICE FRÉCHET: A general expression of repeated nuclei. J. GERONIMUS: The equivalence of two extremal problems. GEORGES BOULIGAND: Growth at a singular point. A. RAUCH: Case where a Borel direction of an integral function $f(z)$ of finite order is also a Borel direction for $f'(z)$. P. THULLEN: Domains of meromorphy. L. SACKMANN: A new method of investigation of an efflux in the immediate neighbourhood of the walls by self-recording of the fluid filaments. CONSTANTIN SĂLCEANU and CALIN POPOVICI: The photometric study of the brightness of the star cluster $M13$. MISSENARD-QUINT: The laws of evaporation. EDGAR PIERRE TAWIL: The laws of the production of electricity by torsion in quartz (strepho-electricity). In the case of a hollow cylinder, the internal and external surfaces are charged with equal quantities of electricity of opposite sign. The quantity is directly proportional to the moment of the couple and to the length of the cylinder, and inversely proportional to the area of the annulus at the end. WILLIAM JEUNEHOMME: The mechanism of the electrochemical chlorination of benzene. Results of a quantitative study of the electrolysis of a mixture of hydrochloric acid, methyl alcohol and benzene. G. KRAVTZOFF: The cathodic behaviour of organic salts of copper. Studies of electrolysis as a function of the time. M. LÉVY: A new method of spectrum analysis of non-periodic curves. GEORGES BRUHAT and PIERRE GRIVET: The rotatory power of quartz for rays perpendicular to the axis and its dispersion in the ultra-violet. ION I. AGARBICEANU: The Zeeman effect and the magnetic weakening of the fluorescence of S_2 and Te_2. ANDRÉ CHARRIOU and MLLE. S. VALETTE: The realisation of acetylcellulose films not deformed by water. For the purpose of aerial photography, the alteration of the linear dimensions of the film produced by immersion in water prevents precision surveys. By varying the chemical composition of the film, the author has succeeded in reducing the deformation to a very low value. GASTON MENIER: A method of ensuring soundness in embankments or barrages. MLLE. SUZANNE VEIL: The autophotographic localisation of radioactive ions in gelatine. In studying the electrolysis of barium chloride in gelatine, if the salt is radioactive, the action of the radium on a photographic plate can be utilised to show the distribution into zones. MAURICE HOLDERER: Why does water wet glass? It is suggested that owing to the variable valencies of the oxygen atom, there may be complex compounds formed between the water and glass, depending on the oxygen valency. It is pointed out that pure mercury does not wet glass, but can do so if a trace of mercury oxide is present. ROBERT TREHIN: Comparative study of the absorption spectra of aqueous solutions of hydrochloric acid and of other chlorides in the ultra-violet.

EDMOND GRILLOT: Lead acetochloride. The salt isolated had the composition Pb_2Ac_3Cl, 1·5 H_2O. Proof that this was a homogeneous compound was obtained. HENRY GAULT and THIBAUT WENDLING: Acetol condensations of acetoacetic ester with acetaldehyde. F. BOUCHAL and V. DOLEJŠEK: An application of Valouch's method, for measuring the constants of crystalline networks, to the precision method of Kunzl and Köppel. NICOLAS THÉOBALD: The fossil insects of the Oligocene strata of Camoins, Céreste and Aix-en-Provence. JEAN LUGEON: The localisation at a great distance of the foci of atmospherics without a radiogoniometer. FERNAND MOREAU and MLLE. C. MORUZI: The sexual bipolarity between Ascomycetes of different species. L. HÉDIN: The heredity of an abnormal maize. MME. SUZANNE LALLEMAND: The faculty and germinative energy of dry, irradiated seeds. The application of very large doses of X-rays (1,000,000 *r*) to dry seeds of the lentil causes the complete loss of germinating power. CHARLES JOYEUX, JEAN GEORGES BAER and PIERRE CARRÈRE: Researches on the evolutive cycle of *Euryhelmis squamula*. PIERRE CAPPE DE BAILLON, MAURICE FAVRELLE and GEORGES DE VICHET: The parthenogenesis of Phasmidæ. PAUL ANCEL and ETIENNE WOLFF: A direct teratogenic method. LOUIS PARROT: The evolution of a Gecko hæmatozoon (*Leishmania tarentolae*) in a stinging gnat of the *Phlebotomus* group (*P. minutus*). HENRI VALLÉE, PAUL RINJARD and MAURICE VALLÉE: Preventative inoculation against paratuberculosis in cattle.

VIENNA

Academy of Sciences, Oct. 18. KARL PRZIBRAM: Natural blue rock-salt (4). Velocity of growth and colour. The pyramidal growths of a blue rock-salt from Thuringia show varying colour. The crystals have grown at different rates along the different cube axes, sudden changes in the velocity relations having occurred. Pyramids which have grown rapidly are darker and more blue, whereas those of slower growth are paler and more violet. These observations accord with the view that the coloration depends on disturbance of the lattice. FRIEDRICH LAUSCHER: Relations between duration of sunshine and total solar radiation. EUGEN GUTH and ARTUR HAAS: Relations between the relativistic mass formula and classical mechanics. The deduction of the relativistic mass formula solely on the basis of the law of the mass of energy. EUGEN GUTH and HERMANN MARK: Intra-molecular statistics, especially of chain molecules. RICHARD WEISS and FRITZ MÜLLER: Triphenylmethanes the benzene nuclei of which are united (8). Reduction products of trimethylenephenylmethane triketone. HERIBERT GRUBITSCH: Investigations on the galvanising of iron. OTTO REDLICH and H. KLINGER: Theory of apparent molecular volume (3): sucrose. It has been shown, with the aid of the Debye-Hückel theory, that the apparent molecular volume of dissolved electrolytes at high dilution is related linearly to the square root of the concentration. That this is a specific effect of free charges is confirmed by the observation that the apparent molecular volume of sucrose in aqueous solutions depends little on the concentration, and at moderately high concentrations of the sucrose is directly proportional to the concentration. RALPH ELBER: Report on the geographical and anthropological results of an expedition through Upper Guinea. JONAS DAGYS: B-growth factors in embryonic tissues and in budding sap. The experimental data recorded indicate that the B-group of growth factors may be divided into two sub-groups comprising (1) those which increase the formation of the dry matter of *Aspergillus niger* in presence of a co-factor, but have no influence on the budding of yeast, and (2) those which also favour increase in the dry matter of *A. niger*, but apparently without the aid of a co-factor, and also promote the budding of yeast and thus diminish its multiplication period. To the first sub-group belong the synthetic growth-promoting substances formed in the autoclave from monosaccharides and many organic acids or their salts, and, to some extent, also the birch-sap factor and rhizopin. Sub-group (2) comprises the constituents of wheat and maize seeds (or their seedlings) and of birch buds and leaves which promote cell-fission. TH. PINTNER: Processes in the development of cestode chains. RUDOLF SIEBER: Further results of palæo-biological investigations on the fauna of the rhætic reef-chalk of the Rötelwand (Osterhorn group, Salzburg) and of other rhætic reef-regions of the Northern Alps. HERMANN WENDELIN: *R*-Integrability of compound functions. AUGUST VERDINO and E. SCHADENDORFF: Condensations of aromatic amines with cholesteryl chloroformate. FRANZ WERNER: Third contribution to the knowledge of the fauna of the Ægean Islands: (1) Introduction and report on the journey, (2) Orthoptera. ADOLF MÜLLER: Preparation of pimelic acid.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 495–538, Sept. 15, 1934). T. H. GOODSPEED and FRED M. UBER: Application of the Altmann freezing-drying technique to plant cytology. The tissue is killed in liquid air and dehydrated in a vacuum at a temperature low enough to prevent diffusion or displacement of cell constituents. A commercial freezing unit charged with methyl chloride was used, with calcium chloride brine. Dehydration for periods up to two weeks and at temperatures between − 22° and − 32° C. have been used. The method seems likely to be of use in investigating the finer details of nuclear and cytoplasmic structure; details of chromosome structure are well brought out in sections of lily anther. WILDER D. BANCROFT and JOHN E. RUTZLER, JR.: Reversible coagulation in living tissue (12). Different doses of sodium rhodanate may produce apparently opposite results. Experiments with sodium amytal anæsthesia in rabbits suggest that small doses of rhodanate force the amytal off the sensory nerves, thereby increasing irritability and tending to awaken the sleeper; more rhodanate brings the sensory nerves nearer normal, thus permitting sleep. ERNEST B. BABCOCK: Genetic evolutionary processes. Extensive study of the genus *Crepis* (Compositæ) leads to the view that they are derived from 10-chromosome ancestors, which, probably by reciprocal translocation between non-homologous chromosomes, have given rise to 8- and 6-chromosome species. It is suggested that this transformation of chromosome complement must be recognised as a cause of evolution, which in some cases at least, is of more importance than gene mutation. A. H. STURTEVANT: Preferential segregation of the fourth chromosomes in *Drosophila melanogaster*. CHESTER STOCK: On the occurrence of an oreodont skeleton in the Sespe of South Mountain, California. A discussion of the probable age of these deposits. NORMAN LEVINSON: On a theorem of Carleman. F. E. WHITE: Some special cases of the

indeterminacy principle. D. H. WEINSTEIN: Modified Ritz method. B. F. SKINNER: A discrimination without previous conditioning. JANE M. OPPENHEIMER: Experiments on early developing stages of *Fundulus*. Differentiation to embryonic structures with the exception of yolk-sac epithelium occurs in blastoderms isolated at the thirty-two cell stage and later; younger blastoderms do not give such structures. Dorsal lip and embryonic shield grafts induce a certain amount of differentiation. The work suggests that, contrary to earlier views, differentiation is influenced by processes during and after gastrulation.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, December 9

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—G. Tandy: "British Seaweeds".*

Monday, December 10

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. W. E. Swinton: "Dragons".*

UNIVERSITY OF LONDON (BROWN INSTITUTION), at 5—(at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1).—Prof. F. W. Twort: "Primitive Forms of Life" (succeeding lectures on December 12, 14, 17 and 19).*

CHADWICK PUBLIC LECTURE, at 5.30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Dr. F. R. Seymour: "Men and Masses".*

UNIVERSITY OF GLASGOW, at 8.30.—Prof. G. W. O. Howe: "National Progress in Electrical Engineering".*

Wednesday, December 12

ROYAL INSTITUTION AND BRITISH SCIENCE GUILD, at 9—(at the Royal Institution).—Dr. G. W. C. Kaye: "Sound and Noise" (Research and Development Lecture).

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP), at 8—(at the London School of Hygiene and Tropical Medicine).—Prof. E. Waldschmidt-Leitz: "Recent Developments in Enzyme Chemistry".*

Thursday, December 13

ROYAL INSTITUTION, at 9.—Dr. Alfred Noyes: "Poetry and Reality".

ROYAL EMPIRE SOCIETY (EDUCATION CIRCLE), at 8.—Discussion on "Character Training in Kashmir", to be opened by E. Tyndale-Biscoe.

Friday, December 14

ROYAL SOCIETY OF ARTS, at 4.30.—A. D. Blaschek: "Indian Forestry—Economic and Commercial Aspects."

SOCIETY OF CHEMICAL INDUSTRY (BIRMINGHAM AND MIDLAND SECTION), at 7.30—(at the University Buildings, Edmund Street).—Sir John Russell: "Applications of Chemistry in Modern Agriculture".*

BRITISH EMPIRE CANCER CAMPAIGN, December 12–13.—Conference on Radiation Therapy.

Official Publications Received

GREAT BRITAIN AND IRELAND

University of Cambridge: Solar Physics Observatory. Twenty-second Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1933 August 1–1934 July 31. Pp. 3. (Cambridge.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1595 (T. 3492): Aileron Stability, with Special Reference to Rolling-Aileron Motion and the Influence of Frise Type Hinge Moment Curves. By A. G. Pugsley. Pp. 29+5 plates. 1*s*. 6*d*. net. No. 1596 (Strut. 160): Flexural-Torsional Flutter of a Simple Cantilever Wing. By D. Williams. Pp. 18+8 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

Thirty-second Annual Report, 1933–1934, of the Imperial Cancer Research Fund. Pp. 32. Eleventh Scientific Report on the Investigations of the Imperial Cancer Research Fund. Pp. ix+177+58 plates. 30*s*. Supplement to Eleventh Scientific Report: The Filterable Tumours of Fowls, a Critical Review. By L. Foulds. Pp. ii+42. (London: Taylor and Francis.)

OTHER COUNTRIES

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1933. Pp. 81. (Bangalore: Indian Institute of Science.)

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra, Australia. Memoir No. 4: Atmospheric Potential Gradient Observations at the Commonwealth Solar Observatory, Mount Stromlo, Canberra. By C. W. Allen. Pp. 47. (Canberra: Government Printer.)

The Peabody Museum of Natural History. Bulletin 3: Hybrid Ducks, including Descriptions of Two Crosses of *Bucephala* and *Lophodytes*. By Stanley C. Ball. Pp. 26+3 plates. (New Haven, Conn.: Yale University.) 25 cents.

Stanford University Publications: University Series. Biological Sciences, Vol. 2, No. 6: Contributions towards a Monograph of the Sucking Lice, Part 6. By Prof. Gordon Floyd Ferris. Pp. 56. 1 dollar. Biological Sciences, Vol. 2, No. 7: Contributions towards a Monograph of the Sucking Lice, Part 7. By Prof. Gordon Floyd Ferris. Pp. 56. 1 dollar. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.)

Smithsonian Miscellaneous Collections. Vol. 92, No. 5: Colonial Formation of Unicellular Green Algæ under various Light Conditions. By Florence E. Meier. (Publication 3256.) Pp. 14+3 plates. Vol. 92, No. 6: Effects of Intensities and Wave Lengths of Light on Unicellular Green Algæ. By Florence E. Meier. (Publication 3257.) Pp. 27+3 plates. Vol. 92, No. 7: Herpetological Collections from the West Indies made by Dr. Paul Bartsch under the Walter Rathbone Bacon Scholarship, 1928–1930. By Doris M. Cochran. (Publication 3259.) Pp. 48. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of the Interior: Office of Education. Guidance Leaflets, Leaflet No. 22: Optometry. By Walter J. Greenleaf. Pp. ii+11. (Washington, D.C.: Government Printing Office.) 5 cents.

Colony and Protectorate of Kenya. Forest Department Annual Report, 1933. Pp. 36. (Nairobi: Government Printer.) 1*s*.

U.S. Department of the Interior: Geological Survey. Bulletin 857–D: Notes on the Geology of the Alaska Peninsula and Aleutian Islands. By Stephen R. Capps. (Mineral Resources of Alaska, 1932.) Pp. ii+141–153+plate 5. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of the Interior: Office of Education. Pamphlet No. 49: Teachers' Problems with Exceptional Children. 3: Mentally Retarded Children. By Elsie H. Martens. Pp. iii+42. (Washington, D.C.: Government Printing Office.) 5 cents.

The Rockefeller Foundation. Annual Report, 1933. Pp. xix+477. (New York City.)

Merentutkimuslaitoksen Julkaisu: Havsforskningsinstitutets Skrift. No. 94: Strom- und Windbeobachtungen an den Feuerschiffen in den Jahren 1932 und 1933. Von A. Palmén. Pp. 55. No. 95: Havsforskningsinstitutets Verksamhet år 1933. Av Gunnar Granquist. Pp. 16. No. 96: A Study of the Sediments of the North Baltic and adjoining Seas. By Stina Gripenberg. Pp. 231. (Helsinki.)

Report of a Committee appointed by His Excellency the Officer administering the Government of the Straits Settlements and High Commissioner for the Malay States to Investigate and Report on the Present Economic Condition of the Coconut and other Vegetable Oil Producing Industries in Malaya. Pp. vii+108. (Kuala Lumpur: Government Press.) 2 dollars.

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 14: Coleopterous Pests of Stored *Derris* in Malaya. By N. C. E. Miller. Pp. ii+34+2 plates. 50 cents. Scientific Series, No. 15: Notes on Hymenopterous Parasites of Padi Pests in Malaya. By H. T. Pagden. Pp. ii+13+4 plates. 50 cents. General Series, No. 19: Reports of the Research, Economic and Agricultural Education Branches for the Year 1933. Pp. iii+84. 50 cents. (Kuala Lumpur: Department of Agriculture.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 4: Geology and Mineralogy. Vol. 2, No. 3: Cretaceous Mollusca from the Miyako District, Honshu, Japan (Lamellibranchiata and Gastropoda). By Takumi Nagao. Pp. 177–277+17 plates. (Sapporo: Hokkaido Imperial University.)

CATALOGUES

Cambridge Pressure and Draught Indicators and Recorders. (Folder No. 47.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Stereocartographe III. Pp. 25. Appareil pour leves aerophotogrammetriques. Pp. 16. Mezzo secolo di fotogrammetria, 1884–1934. Pp. 39. (Firenze: Officine Galileo.)

Classified List of Second-Hand Scientific Instruments. (No. 106.) Pp. 58. (London: C. Baker.)

Catalogue of Medical Books, including Dentistry, Nursing, Sexology, Ophthalmology, Pharmacy, Surgery, First Aid, Hygiene, etc. Pp. 68. (London: W. and G. Foyle, Ltd.)

Books for Pleasure and Profit at greatly Reduced Prices. (Catalogue 440.) Pp. 42. (Cambridge: W. Heffer and Sons, Ltd.)

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CONTENTS

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Inland Water Survey

THE announcement made in the House of Commons on December 7 by the Minister of Health that he had "decided that a comprehensive inland water survey shall be undertaken for Great Britain" will undoubtedly be received with a feeling of widespread satisfaction. It marks the successful culmination of a movement which has been constantly supported and earnestly advocated by NATURE, with, as we confidently believe, the sympathetic interest of our readers, especially those who are in any way concerned with the technical use and exploitation of water. The solitary position of Great Britain, alone among the more important nations of the world in failing to keep a systematic and reliable record of its water resources, has long been a reproach to its administrators and a source of regret and inconvenience in scientific and engineering circles. It is welcome news that the defect is to be remedied. The statement of the Minister of Health goes on to explain that "a water survey committee, composed of persons outside Government Departments, will be appointed to advise on the survey and on the progress of the measures undertaken". The precise constitution of this committee remains to be seen, as also the scope of the proposed operations; but on these points there may be occasion for comment later.

There is one feature, however, of the ministerial statement which, it must be avowed, produces a sense of disappointment. Reading the verbatim report of Sir Hilton Young's speech in the House of Commons, as also the supplementary remarks which he made the same day to the Institution of Water Engineers, any member of the general public, unacquainted with the inner history of the movement, might certainly conclude that the Ministry of Health is moving in the matter quite spontaneously and on its own initiative.

The inception of the proposal for a national survey can, however, be traced back a century, when the eminent engineer, Telford, was commissioned to report on the "Means of Supplying the Metropolis with Pure Water" and put forward a suggestion of this nature. In the subsequent period down to the present day, the recommendation was reiterated on numerous occasions in the proceedings of scientific and technical societies and in reports presented by successive departmental commissions of inquiry. These various reports were duly 'received', filed—and forgotten.

The matter developed with relative rapidity to its present stage quite definitely within the last eight or ten years, through the agency of a small private organisation, known as River Flow Records, promoted by Capt. W. N. McClean, who undertook gauging operations in certain river basins in Scotland with the object of giving practical demonstration of the way in which gauging records of the principal water areas in Great Britain might be kept. At the meeting of the British Association at York in September 1932, he introduced a discussion on the subject with a memorandum in which he directed attention to the essential value and fundamental importance of reliable records of water measurement in all problems connected not only with supplies of water for domestic consumption, but also for purposes of industry and commerce, power, navigation, irrigation, drainage and many other matters of public service. In the discussion which followed, the speakers were unanimous in affirming their conviction of the necessity for a national survey. Accordingly, on the joint recommendation of Sections A, E and G (Mathematical and Physical Sciences, Geography and Engineering), the General Committee of the Association approved the appointment of a research committee with instructions "to inquire into the position of Inland Water Survey in the British Isles and the possible organisation and control of such a survey by central authority". The Committee at its first meeting elected Vice-Admiral Sir Percy Douglas as chairman, Lieut.-Col. E. Gold as vice-chairman and Capt. W. N. McClean as hon. secretary. It also co-opted, with official cognizance and approval, representatives of the various Government Departments interested.

The Committee then made a careful and painstaking investigation extending over many months into all the available sources of information, and the following year it was in a position to present its first report (a lengthy document of 69 pages with numerous appendices containing detailed information) to the meeting of the Association at Leicester. This report was summarised in the issue of NATURE of November 11, 1933: its main conclusions were: (1) that a systematic survey of the water resources of Great Britain is urgently required; and (2) that the survey, in order to be of maximum utility, should be conducted by a central organisation, preferably under a Government department, independent of any interest in the administration, control or use of water.

At this stage, having regard (on account of the economic conditions prevailing at the time) to the impracticability of obtaining a grant from the public funds for the purpose of instituting the proposed survey, it was decided to invite the co-operation of the Institution of Civil Engineers, the Council of which body had offered to appoint a committee to investigate the feasibility of carrying out the objects outlined in the report on a self-supporting basis. Unfortunately, from lack of the necessary financial support, this scheme was found to be impracticable of realisation. It was then decided by a joint committee of the British Association and the Institution that the time had arrived when an appeal should be made to the Government on grounds of national utility and importance, exemplified by the situation arising out of the recent drought. The Prime Minister was approached through a memorandum signed by the respective presidents of the Association and the Institution, asking that he would be good enough to receive a deputation on the matter. As Mr. MacDonald was then on the point of leaving for Canada, the deputation was received in his stead by Sir Hilton Young on July 17 last. Having listened to the representations put forward, the Minister of Health promised that they should receive the most careful consideration of the Government.

No action or decision had, however, been announced from Whitehall at the time of the Aberdeen meeting of the British Association in September, when there was a full discussion of the subject and four Sections of the Association (this time including Geology) passed a joint resolution expressing the hope that the Government would decide upon "the establishment of an organised survey of the water resources of the country on a scientific basis". Now after two years of sustained investigation and advocacy by its promoters the fiat has gone forth that the survey is to be undertaken.

The foregoing account sets the present development in its proper sequence and enables the matter to be viewed in the right perspective. We have no wish to undervalue the care and attention which has been given to the proposal by the Ministry of Health and other Departments, but we have every reason for attributing the successful issue of the movement to the untiring efforts of its advocates. It is to the British Association and the Institution of Civil Engineers that credit must be given for the realisation of the demand for a national water survey.

Planning of Industry and Labour Supply

THE reports of the investigations into the industrial conditions in certain economically depressed areas of the north of England, South Wales and Scotland* afford an impressive piece of evidence of the necessity for industrial planning on national lines if untoward social consequences are to be avoided. The picture of Durham and Tyneside, where whole areas have been drained of vitality, with the production of an attitude of resignation and of an incapacity to return to work when opportunity offers, through sheer lack of confidence and vitality, is appalling. Even this, and the urgent necessity of arresting the present decline, cannot overshadow Mr. J. C. C. Davidson's significant remarks on the need for a continuous survey of the problems of the depressed areas, and his endorsement of the recommendations of surveys recently made by the University of Liverpool that the State should devote greater resources to continuous intensive regional research, and play a greater part in regulating the initial location of new industries or businesses. His further conclusion that the worst problems in West Cumberland cannot be treated in isolation, but that the district must be treated as a whole, is in keeping with the conclusions reached by Sir Arthur Rose for Scotland and Sir Wyndham Portal for South Wales. All four commissioners, in fact, are at pains to emphasise the necessity for a national policy in regard to industrial transference and the development of new industries.

The report on West Cumberland indicates that this area is likely to have, for years to come, a substantial surplus of labour with no hope of outlet locally. There is little prospect of attracting new manufacturing industries, but on the other hand agriculture appears to offer greater possibilities than in the other areas, and afforestation also offers scope for development.

The need for a national policy is brought out very clearly by Capt. D. Euan Wallace in his report on Durham and Tyneside. He urges that steps be taken towards the national planning of industry, and recommends the unification of coal-mining royalties, the formation of an Industrial Development Company for Tyneside and a land settlement scheme financed by the Exchequer, as well as the clearance of derelict sites. Similarly, Sir Wyndham Portal directs attention to the danger of the situation in South Wales, which is practically dependent on the coal trade alone, being repeated in other parts of the country which rely on a single industry. If the economic planning of factories is not accompanied by the economic planning of labour supply, distressed areas may spring up in other places; planning of industry involves the simultaneous planning of labour supply. Already dangerous tendencies exist in the starting of steel and tinplate industries in Lincolnshire. The chief hope of industrial development in South Wales appears to be in the adoption of more scientific methods of utilising coal, and special reference is made to the possibility of the hydrogenation of coal being undertaken in South Wales. Pembroke, moreover, has outstanding claims for Government controlled works, and special stress is laid on the recommendation that some such factory should be located in the South Wales area.

The report on Scotland indicates that the problem there is not strictly one of derelict areas. There is evidence of definite surpluses of labour in the shalefields, North Ayrshire and Lanarkshire. The conditions in the whole area are mainly due to world conditions, and the removal of hindrances to international trade would go far to remedy matters. The tendency for industry to move south has deprived Scotland of the advantages of the new industrial developments, and it is considered that a designed direction of Government orders in rather larger proportions to the Clyde area would alleviate in a remarkably wide degree, and out of proportion to what it would do in other areas, the widespread and severe conditions of depression.

All of the commissioners allude to the growing volume of juvenile unemployment through the increasing number of 'school-leavers', and emphasise the importance of strenuous efforts at transfer. None of the reports, however, discusses the absorption capacity of other districts for this surplus, and Capt. Wallace is alone in referring to the effect on juvenile unemployment of raising the school leaving age, in spite of the close relation of this step to that of juvenile unemployment in Great Britain as a whole. The reports are thus silent on one of the most critical and serious problems of the whole country—the prevention of the development of a hard core of juvenile unemployables, who have never known regular occupation, or at most, known it only for a year or two before displacement by fresh school-leavers.

* Ministry of Labour. Reports of Investigations into the Industrial Conditions in Certain Depressed Areas of (1) West Cumberland and Haltwhistle, (2) Durham and Tyneside, (3) South Wales and Monmouthshire, (4) Scotland. (Cmd. 4728.) Pp. 240. (London: H.M. Stationery Office, 1934.) 3s. 6d. net.

Principles of the Art of Electrical Communication

Signals and Speech in Electrical Communication. By John Mills. Pp. vi+281. (New York: Harcourt, Brace and Co., 1934.) n.p.

THE development of the methods used in communicating by electricity of recent years has been so rapid that few appreciate what has already been done and fewer still can make a guess at the nature of the developments the future has in store. In this connexion a suggestive collection of essays by Mr. John Mills will prove helpful to the ordinary reader, enabling him to understand the general principles used in the art of electrical communication and the limitations to which it is subject.

The first essay is on the 'vivisection' of speech. We may say that an engineer can now 'anæsthetise' a sound wave by means of a transmitter, lay it out on a pair of telephone wires, remove various of its components and amplify and rearrange others. We then hear to what extent the sound has become less recognisable. The Bell Telephone Laboratories have made many useful researches on the effects of distorting the wave. In the days before the advent of electrically cut records, the graver of the phonograph was operated directly by the sound waves it recorded. It was moved by a diaphragm at the base of the horn which acted like an ear trumpet in catching the sound. As a complex sound wave had to be recorded, any faint component notes had little chance of being preserved on the wax. In the process of recording the human voice and the lower notes of musical instruments, the fundamental tones lost nearly all the higher overtones and frequently some of the lower overtones. We now see that the human ear was an unrecognised but invaluable helper of the phonograph industry in its early days. Its inadequacy as an analyser of a complex musical sound explains how it could tolerate such imperfect reproductions of music.

Perfection is always expensive and in many cases is not necessary. What is done and what can be done in the way of transmitting and reproducing speech and music by means of a limited number of tones is marvellous. Experiments show that if we transmit all the component tones of speech the vibration frequencies of which lie between a hundred and three thousand, then it is easy to understand. Radio broadcasting has now for some time utilised the range to five thousand. The regulations at present limit it to this amount.

Mr. Mills discusses the question of whether an electrical system will ever transmit for us the particles necessary for taste and smell. So far, no solution of these problems has yet been suggested. Those delicate and discriminating senses which lead so directly into our emotional substrata seem destined never to reach us from a distance. Even if the chemist and the psychologist could reduce the range of these senses to a limited number of elementary sensations, the synthesis seems to require at the receiving end the actual presence of the necessary elements. On the other hand, the sense of feeling presents none of these difficulties. Doubtless mechanisms could be devised for this purpose by striking blows and exerting pressures, but it is difficult to see any useful end that would be served.

The essay on modulation, which the author calls the marriage of currents, gives a clear picture of what is meant by carrier currents. The marriage of two harmonic currents, one with a frequency of twelve and another with a frequency of two, gives rise to two offspring, one with a frequency of 14 and the other with a frequency of 10. A carrier current and two side band currents surge backwards and forwards according to their respective frequencies. The carrier current comes from the generator, and the current to modulate the carrier from the telephone line from the studio. The intelligence is carried by the side bands. International regulations do not allow these bands to extend over a width of more than five kilocycles above and below the licensed carrier frequency. The operation of demodulation, that is, of detecting the original modulating current, is more complicated and requires delicate adjustments.

The further a telephone signal proceeds from its source the weaker it becomes. In technical language, this is called attenuation. Heaviside, by analysing the causes of attenuation, saw that this could be largely overcome by loading, that is, by putting inductance coils in the line. Then came the notion of electrons, which clearly explained the Edison effect and the Fleming valve and led to the repeater valve, which enables signals to be sent over thousands of miles.

Good manners over the telephone have been so fostered by telephone companies and business organisations that they have become almost universal. Consequently the possibility of countering telephone discourtesy has been little appreciated. A person who after calling has left his telephone for an inconsiderate time, while nominally seeking some desired information, might be hurried by making the telephone make a brief howl. To do this, all that is generally necessary is to hold the telephone against the mouthpiece. With a handset this would of course be as impossible as whispering into one's own ear. The principle used is the same as that of a repeater,

which makes a receiver talk into a transmitter and then amplifies the sound.

When hearing is under consideration, it is convenient to describe sounds by the number of steps above a sound which is just audible and gives the threshold of hearing. The telephone engineer describes sound by the number of 'decibels' above the threshold. For the layman it is sufficient to remember that for every ten decibels there is a tenfold increase of power, and that an increase of three decibels, which corresponds approximately to doubling the power, is about the smallest increase that he is able to detect. His ears, for frequencies lying between 500 and 2,000 cycles per second, the range where hearing is keenest, can accommodate themselves to sounds extending about 130 decibels above the minimum audible intensity. For more intense sounds, auditory perception is masked by pain and the threshold of 'feeling' is reached. This also is about the level of the noise in busy streets. Near an aeroplane engine, the noise will be about thirty decibels higher than in a busy street. The ears of listeners will therefore be subjected to a sound power a million times larger. In a quiet suburban garden, the noise level may be only ten or twenty decibels above the level of zero sensation.

Science or Propaganda?

Heredity and the Social Problem Group. By E. J. Lidbetter. Vol. 1. Pp. 160+26 plates. (London: Edward Arnold and Co., 1933.) 21*s.* net.

THE book before us is based on an extremely painstaking study of persons receiving assistance from the Poor Law authorities in an area of East London, and their relatives. The results are embodied in twenty-six pedigrees, some of which contain several hundred individuals. They are classified according to the amount, if any, of assistance received from the rates, and also on a basis of physical and mental defects and of criminality. The investigation has been going on since 1913, and the author must be congratulated on his industry. A second volume is promised, dealing with a control group, and drawing conclusions. It may be hoped that this volume will include a statement of the criteria employed in assessing mental defect, and also as to the proportion of the whole pauper population which is included in these records. Unless this proportion is quite high, it is obvious that false conclusions may be drawn from the selection of the material.

The author states "that in this volume nothing more is attempted than to present a record of comparable facts, and that generalisations and analysis are reserved to a later volume". If this were true, the work would be a valuable social document. But it is far from true. The title alone begs two questions. It seems to be assumed that where undesirable characters occur in several generations we are concerned with heredity. This is no doubt true of the blindness in pedigree I, and highly probable in some other pedigrees. On the other hand, the frequent mention of venereal disease makes it clear that a good deal of the blindness, mental defect and insanity was due to this environmental cause. We find various defects among children brought up in Poor Law institutions and in conditions of great poverty. In view of the known effects of diet upon mental and physical health, it would be more possible to assess the part played by heredity in the causation of these defects if a few typical dietaries were given. For example, it would be interesting to know how much milk was drunk per week in 1900 by a five-year-old child in a typical family of this group. The author makes no suggestion that malnutrition may have played any part in determining the defects with which he deals.

The term 'social problem group' is applied to a small group who under pre-War conditions were chronically unemployed. Since 1921, this phrase has been out of date. Our main social problem to-day is the unemployment of persons able and willing to work, and the social problem group to-day is the group responsible for this fact. Some economists blame the owners of unused bank balances, others the technicians whose inventions have displaced labour; whoever else is to blame, the subjects of this book are not.

In spite of his disclaimer, quoted above, the author has been guilty of the most startling generalisations. Of the irregular unions common among his subjects he writes: "Such conditions may exist in other sections of the community, but if so they are unknown to the writer". A study of divorce decrees might convince him that unions of this type are frequent among certain sections of the rich. Again, Mr. Lidbetter believes in "the impossibility of considering biological problems upon an examination of pedigrees consisting only of two or even three generations". Yet our knowledge of the inheritance of blood group membership and taste-blindness is entirely built on such pedigrees. For such reasons as these, we must question the author's deductions from the data presented.

Even if the pedigrees show inheritance, it is not clear what is inherited in most cases. The people concerned were ill-adapted to life in East London. But one who (p. 87) had "spent most of his life in the workhouse, or in prison" rose to commissioned rank in the army, and ceased to be a burden on the rates; that is to say, he was a success in a different environment. Unless the

author contemplates the permanency of the East London environment, he has no more right to describe most of his subjects as socially inadequate because they failed there, than to describe a Jersey cow as agriculturally inadequate because she fails on the South African veldt. Unfortunately, such considerations will not occur to all the readers of this book.

The statement on pp. 19–20 that the socially inadequate are endowed at the expense of the self-supporting community could be used for any sort of propaganda, for example, against capitalism or the drink trade. It is here applied to the chronic pauper, with the further suggestion that the inadequacy is congenital. This is as legitimate as most other political propaganda, but it seems very unfortunate that it should be carried out with funds supplied by such bodies as the Medical Research Council and the Royal Society. Moreover, the obvious political bias displayed is likely to have the opposite effect to that intended. Some members of the 'social problem group' almost certainly bear genes which would lower their efficiency in any environment, and thus present a real problem for the eugenist. Readers who disagree with Mr. Lidbetter's opinions on politics and economics will be likely to overlook this fact.

Undoubtedly many readers will disagree with the reviewer, and regard this work as an important contribution to human biology. It is unquestionably a storehouse of valuable facts, but they would have been more impressive to the reviewer had the political opinions of their collector been less obvious. Is it too late to hope that, in the promised second volume of this work, a serious attempt will be made to assess the relative importance of nature and nurture in determining the characteristics of the men and women here described? J. B. S. H.

The Human Outlook in Botany

Everyday Botany. By L. J. F. Brimble. Pp. viii+589. (London: Macmillan and Co., Ltd., 1934.) 7*s*. 6*d*.

THERE is no doubt that the study of botany is less commonly regarded as of general importance than is that of chemistry and physics, which seem to touch more closely our everyday life with their direct bearings on the chemical industries, on electricity, telephony, wireless and so on. Yet a knowledge of plant life is essential to the development of agriculture, the oldest and most widespread of human occupations, and those countless individuals who cultivate allotments or seek to embellish their surroundings by trim and attractive gardens would be more successful in their pursuits if they had some understanding of the needs of the plants they grow. Unfortunately, their education in this direction has usually been neglected.

It is to be regretted that even in these days, when the importance of science in our national life is beginning to meet with more recognition, the biological sciences are still absent from the curriculum of many boys' schools. Perhaps the ordinary textbooks of botany have not convinced the headmasters of the human interest and the universal importance of the subject. Mr. Brimble has endeavoured to meet this defect in his "Everyday Botany" by including in an elementary book dealing with plant life many features which indicate the utility to man of many important plants and plant products. By emphasising the human side of botany and maintaining a wide outlook on the important practical applications of a study of plants, the author fully justifies the publication of a new textbook, which it is to be hoped will meet with a warm welcome.

It is natural and fitting that the treatment of the subject matter should have a physiological bias, for it is the life of the plant which is of prime importance in considering its cultivation. But a knowledge of its structure is essential too, for structure and function of the various organs go hand in hand. Both aspects are adequately dealt with and the text is clear and readable, continually lightened for the general reader, for whom the book is primarily written, by reference to interesting facts which should be of common knowledge, but unfortunately are not. The treatment remains, however, always scientific, and the scope of the book is sufficiently comprehensive to serve as an adequate preparation for the various School Certificate and Matriculation examinations. One of the features which will attract both pupils and teachers is the wealth of illustrations, a large number being reproductions of excellent drawings by the author.

Having dealt with the plant as a whole, Mr. Brimble devotes a special chapter to the plant and its surroundings, an attractive introduction to the modern branch of botany known as ecology. This is followed by a chapter on evolution and plant-breeding, which fittingly indicates one of the paths of future progress in agriculture and horticulture. In this chapter, as indeed throughout the book, the author indicates by reference to former and present investigators the course of the development of botanical science, and manages to convey to the mind of the reader that botany is a progressive science and that it has its part to play in the progress of human affairs. In this as in other ways the book is stimulating in its effect upon the reader, and it will without doubt be found most useful to all who wish to acquire a knowledge of plant life.

Short Notices

Index Kewensis Plantarum Phanerogamarum. Supplementum Octavum Nomina et Synonyma Omnium Generum et Specierum ab initio Anni MDCCCCXXVI usque ad finem Anni MDCCCCXXX nonnulla etiam antea edita complectens. Ductu et consilio A. W. Hill. Confecerunt Herbarii Horti Regii Botanici Kewensis Curatores. Pp. iii+256. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 75*s*. net.

THERE is always a welcome for a new supplement of the "Index Kewensis", which supplies the botanist with a list of the names of genera and species published during a five-year period, and thanks are due to Miss Green and Dr. Sprague of the Kew Herbarium for the skilled and careful labour involved in its compilation. A useful innovation in this eighth supplement is the inclusion as an appendix of an alphabetical list of new or previously overlooked generic names under their respective families.

In the "Index" the name of the genus is followed by an indication of the family to which it belongs; new specific epithets are followed by the name which, in the opinion of the author, it should replace. Hybrids are also indicated. Appreciation of the rule that requires a Latin diagnosis to ensure validity of a new name is expressed, as in the case of the various Kew floras, by the additional reference which renders it valid. There is a fair sprinkling of *nomina nuda*—mere ghosts without body—and as botanists have agreed to neglect these it seems unnecessary to index them. A bad case is found under *Mentha*—of 60 entries 39 are *nomina nuda*.

It would be of interest to estimate the proportion of novelties represented by the new names but this varies widely from page to page. A small proportion only of those of genera represent plants new to science; mainly are they expressions of new views, to a large extent individual and sometimes conflicting, as to the limitations of genera; the long lists under the families Ficoidaceae and Leguminosae are striking examples. These alterations are responsible for correspondingly long lists of new combinations in the index of species. For number of entries *Hieracium* (hawkweeds) takes the prize, filling eighteen columns of 'novelties' nearly all from Norway and Sweden. We extend our sympathy to the Scandinavian botanists.

It is no faint praise to say that the new "Index" is as interesting reading as is a dictionary. It mirrors present tendencies of views on taxonomy as well as records the progress of monographic work and the botanical exploration of less-known parts of the world.

A. B. R.

Exploring the Unconscious: Further Exercises in Applied Analytical Psychology. By Dr. Georg Groddeck. Pp. 224. (London: The C. W. Daniel Co., 1933.) 7*s*. 6*d*. net.

THIS excellently translated provocative book consists of a selection from the writings of Dr. Groddeck. For him, life is greater than its manifestations and the human being than his symptoms. While his profession as physician provides his problems and so far determines their expression, it does not limit his outlook. To him all human activities are the work of some unknown, called by him the 'It' as the most impersonal word available, and if we would understand illness, mental or physical, literature, art and music we must learn the language by means of which this unknown expresses itself, frequently a difficult cipher for which we have no ready-to-hand key. The physician trying to interpret bodily symptoms is advised not to overlook the unconscious factors and he is shown that the very method that will help him in this will also illumine the problems of Faust, Peer Gynt and the "Ring", as well as some vexed riddles of philology, of music and art.

Some of the symbolism among which Dr. Groddeck moves with ease will be beyond many readers, but will provoke others to test it for themselves. He emphasises to a much greater extent than most psycho-therapists the importance of synthesising as well as analysing, and the rôle of repression is far more adequately dealt with than elsewhere. The ideas to some will seem fantastic, to others alluring: to all whose work demands an interest in human beings his general conceptions are worthy of consideration, at least, as hypotheses to be tried out.

An interesting and attractive personality reveals itself in this unusual book, and the translation is so good that one is not aware that it is not in its original form.

Plane and Geodetic Surveying: for Engineers. By David Clark. (Glasgow Text Books of Civil Engineering.) Vol. 2: *Higher Surveying.* Second edition, revised and enlarged. Pp. xii+312. (London: Constable and Co., Ltd., 1934.) 25*s*. net.

THIS work is already well known as a standard book on the subject of geodetic surveying; and the new edition should go far to uphold the reputation of the old. The diagrams and photographs are clearly reproduced, and the subject matter is set out in a readable manner. The problems set at the end of each section are extremely useful, and possess the advantage of having the answers appended to them. It would perhaps have been preferable to use letters on the illustrations of such instruments as the theodolite in order to show the constituent parts more clearly; no description of the application of aerial photography to modern surveying is included, and the section dealing with map projections seems to be somewhat condensed. The difficult question of the rapid adjustment of errors in triangulation surveys is admirably dealt with, especially by the method of conditioned quantities.

Altogether, this work can be described as well suited to the needs of students reading for pass and honours degrees in engineering, and for those who desire more detailed knowledge of advanced surveying than is given in the usual textbooks.

B. H. K.

Polarimetric Methods in Chemistry*

By PROF. T. M. LOWRY, C.B.E., F.R.S.

MUTAROTATION

NEARLY forty years ago, as a student of organic chemistry under Prof. H. E. Armstrong, I undertook my first research, on the stereochemistry of the α-derivatives of camphor. The earliest experiments showed that the bromination of α-chlorocamphor and the chlorination of α-bromocamphor both gave an isomorphous mixture of stereoisomeric αα′- and α′α-chlorobromocamphors. It was then natural to extend the research to the nitro-derivatives. For this purpose it was necessary not only to nitrate bromocamphor, but also to brominate nitrocamphor. In this way I first encountered the nitro-compound, $C_{10}H_{15}O.NO_2$, which has already provided a material basis for two extensive series of researches, and has not yet exhausted its utility or interest.

The first of a series of happy chances was a measurement of the optical rotatory power of a solution of nitrocamphor in the morning, followed by a confirmatory reading in the afternoon. During the luncheon interval the rotatory power of the solution had become quite different, and I was thus presented with a novel example of the phenomenon of change of rotatory power with time, which Dubrunfaut had first observed in 1846 in a freshly prepared aqueous solution of glucose. This property of the reducing sugars had been variously described as birotation, multirotation, and paucirotation, according as the ratio of the initial to the final rotation was 2 : 1, greater than 1 or less than 1; but, since in certain solvents the *sign* as well as the magnitude of the rotation of nitrocamphor was changed, I suggested in 1899 that the phenomenon should be described as *mutarotation*; and this name has been in general use ever since.

The chemical basis of the phenomenon was disclosed by another happy accident. Wishing to know whether the change of rotatory power could be repeated when the nitrocamphor had been recovered from solution, I left a solution in benzene to evaporate on the water bath. Later in the day I examined the residue and found that it was now almost entirely insoluble in benzene. It had in fact been converted into a new compound, an anhydride formed from nitrocamphor by the loss of half a molecular proportion of water. An anhydride of this type could not be formed directly from nitrocamphor itself, but it could be derived easily enough from an isomeric hydroxylic form of the substance, such as that from which the salts of nitrocamphor were presumably derived. This conclusion was confirmed by the fact that the anhydride of lævorotatory nitrocamphor was, like the salts, strongly dextrorotatory. The mutarotation of nitrocamphor, always from left towards right, could therefore be attributed to a partial conversion in solution of lævorotatory nitrocamphor into a dextrorotatory isomeride, containing an acidic hydroxyl group, which was capable of forming an anhydride as well as a series of salts.

At this stage, Prof. Kipping very generously gave me a quantity of the π-bromo-derivative of α-bromonitrocamphor, from which I was able to prepare a stock of π-bromonitrocamphor. Lapworth and Kipping had described this compound as trimorphous, and had recorded the crystal constants and published drawings of two of the forms. The orthorhombic form, melting at 142°, proved to be strongly dextrorotatory when dissolved in benzene, but it became lævorotatory after a few hours. The tetragonal form, melting at 108° (which is formed as a by-product, alongside the more stable form, by rapid evaporation of a solution in chloroform), was found to be lævorotatory, but like nitrocamphor it exhibited a relatively small mutarotation from left towards right. This labile form was therefore analogous with ordinary nitrocamphor, whilst the more stable form was analogous with the still unknown pseudo-nitrocamphor, the relative stability of the two isomers having been reversed by the introduction of a halogen. The third form, for which no crystal measurements had been published, was evidently a mere mixture of these two isomers.

The mutarotation of the sugars in aqueous solutions had been attributed to several causes; but, when Emil Fischer observed the same phenomenon during the reversible hydrolysis of the sugar lactones, he concluded that these changes of rotatory power were due to reversible hydration, and this conclusion was very widely accepted. This explanation can obviously be applied to any aqueous solution in which reversible hydrolysis can take place; but it was not applicable to nitrocamphor, which exhibited mutarotation in a large range of anhydrous solvents, but was too insoluble to be examined in aqueous solutions. Since interaction with the solvent was thus excluded, the mutarotation of nitrocamphor could only be attributed to *dissociation* or to *isomeric or polymeric change*.

* From the presidential address entitled "Physical Methods in Chemistry" to Section B (Chemistry) of the British Association, delivered at Aberdeen on September 6.

At that date, certain sugars had already been prepared in two isomeric forms, which exhibited mutarotation in opposite directions; but these changes were attributed to the complete conversion of the two sugars into a third isomeride. In the case of π-bromonitrocamphor, however, the product of mutarotation of the normal and pseudo forms was obviously an equilibrium mixture of these two substances, and not a third isomeride, since, on evaporation of the solution, crystals of the normal and pseudo forms were deposited side by side. Mutarotation was therefore attributed to the *reversible isomeric change* of two isomers; and this interpretation was regarded as generally applicable to mutarotations in which interaction with the solvent could be excluded.

Dynamic Isomerism

The phenomenon of reversible isomeric change had been studied, and its essential characteristics had been fully elucidated, twenty-two years before by Butlerow in 1877. He had shown that two isomeric forms of the unsaturated hydrocarbon, *iso*dibutylene, C_8H_{16}, could be brought into equilibrium by the reversible addition of sulphuric acid, since a molecule of sulphuric acid could be removed from the acid sulphate in two different ways. Simultaneously, two *iso*dibutyl alcohols of the formula $C_8H_{18}O$, in the form of their acid sulphates, were brought into equilibrium by the reversible elimination of sulphuric acid, since the resulting olefine could add on sulphuric acid in two different ways:

$$C_8H_{16} + H_2SO_4 \rightleftharpoons C_8H_{17}O.SO_2.OH$$

Butlerow also recognised that, although sulphuric acid was required to bring the isomeric olefines and alcohols into equilibrium, the introduction of a catalyst might not be required in other cases. In particular, he suggested that prussic acid might be regarded as an equilibrium mixture of the two acids, HCN and HNC, from which the cyanides and *iso*cyanides $CH_3.CN$ and $CH_3.NC$ are derived:

$$CH_3.CN \leftarrow HCN \rightleftharpoons HNC \rightarrow CH_3.NC$$

Methyl cyanide. Prussic acid. Methyl *iso*cyanide.

Butlerow's paper did not receive the attention that it deserved, perhaps because it was published under the too modest title "On Isodibutylene". Much more interest was aroused by the publication, eight years later, by Laar, of a speculative paper "On the Possibility of Several Structural Formulæ for the Same Chemical Compound". Laar assumed that the dual reactivity of certain substances, of which ethyl acetoacetate is now the most familiar example, might be due to the incessant wandering of a hydrogen atom between two alternative positions in the molecule. In order to make his theory more precise, he compared these internal migrations with the vibrations which give rise to radiation in incandescent gases. To this phenomenon he gave the name of *tautomerism*, and in order to emphasise the contrast with Butlerow's phenomenon of reversible isomeric change, he stated categorically that the substances represented by the two alternative structural formulæ were "not isomeric but identical".

Since two isomeric forms of π-bromonitrocamphor had been isolated in the crystalline state, and their slow progress towards equilibrium in solution had been followed by observations of mutarotation, it would have been absurd to describe them as identical, or, in terms of Laar's definition, as tautomeric. These well-defined compounds, however, provided an excellent illustration of Butlerow's phenomenon of "equilibrium between isomers". I therefore ventured to describe this phenomenon in very obvious terms as *dynamic isomerism*, in contrast to the more usual condition of static isomerism, in which each isomer preserves its individuality and is not in process of conversion into any other substance of similar composition.

(*To be continued.*)

The Metamorphosis of Paper

ONE of the results of the application of scientific methods to the cellulose industries, and in particular to paper, has been a realisation of the considerable inherent strength of the unit fibre. One would, of course, hesitate to select paper for any purpose for which great strength is essential, but at the same time it must be remembered that, when paper is broken, it is usually the bonds connecting the fibres, and not the fibres themselves, which are ruptured. Reliable figures are necessarily difficult to obtain, but actual measurements indicate that, weight for weight, the tensile strengths of certain cellulose fibres and of wires made from light metals are of the same order (cf. NATURE, 131, 553, April 15, 1933).

It is not unnatural, therefore, that many attempts have been made to produce paper products having the equivalent in strength and durability of more resistant materials such as cloth, leather, wood and even metal, and in such cases attention has usually been concentrated on strengthening the bonds between the fibres both laterally and longitudinally, on the reasonable assumption that the individual fibres can take care of themselves. By selecting the strongest of

fibres and treating them mechanically in the paper-mill beater, it is possible to split the ends of the fibres into smaller fibrillæ which intertwine on the paper-machine and develop considerable strength, but there is obviously a limit to the extent to which this can be carried, and this limit precludes paper completely as a competitor even to a woven fabric.

The most promising results have been obtained by processes of impregnation, in which the fibres are held together by addition of an independent consolidating material. Thus, if paper is passed through zinc chloride or sulphuric acid under controlled conditions of concentration and temperature, the cellulose is modified in such a way as to form a hard impervious surface layer. This so-called 'vulcanising' process not only imparts a certain amount of strength and solidity to the sheet, but also, if a laminated product is made by pressing sheets into intimate contact before the hardening process is complete, a hard material having many of the properties of wood is obtained. Materials of this type, for example, fibrous plasters, mixtures of paper and glue, and laminated paper products made by impregnation with synthetic resins, have been available for many years, but have not hitherto been obtainable in the form of a strong flexible sheet.

The methods suggested for strengthening fibres by simple immersion in a bath occupy a share of the patent literature far out of proportion with the value of the material they produce. There are, however, several outstanding exceptions, one of which is rubber. Absorbent paper containing more than 90 per cent of α-cellulose can be heavily impregnated with rubber either as a latex suspension or dissolved in a solvent, and the resulting product, when suitably coloured, finished and embossed is an excellent imitation of leather or cloth, from the point of view not only of appearance but also of strength and durability.

Another very successful product, but of a rather different character, is "Linson", which is described as a cellulose fabric. This gives a partial clue to its identity, although the base material is manilla, which is one of the strongest vegetable fibres known. The great strength of Linson is indicated by the fact that the folding-resistance is almost ten times that of an ordinary bookbinding cloth. The difficulty of producing a high-glazed, water-repellent finish without brittleness seems to have been overcome, and not only is it possible to scour or polish the surface without damage or removal of colour, but also the resistance to oil and petrol gives it a considerable advantage over the numerous cellulose lacquers at present available for waterproofing. Resistance to water is usually and for obvious reasons incompatible with suitability for work with adhesives, but Linson must be ranked with the few products of its kind which fulfil both requirements satisfactorily. Apart from alkalis, fairly strong acids and certain organic solvents (which may be regarded as unfairly stringent tests) we have found only one medium which it will not resist without change, and that is hot water ; the effects of storage and weathering have, however, yet to be tested.

Numerous uses for this class of material at once suggest themselves, but mention may be made here of all kinds of substitutes for the poorer and thinner varieties of leather, for bookbinding material, motor-car roofings, desk-tops and (since it can be sewn, washed, ironed and blocked) even for clothes. J. G.

Recent Aeronautical Research

THE annual report for 1933–34 of the Aeronautical Research Committee covers the work of the first year under the new chairmanship of Mr. H. T. Tizard.* It summarises the position to-day with regard to actual flight that "flying may now be regarded as a safe means of transport. This is due on the one hand to the steadily increasing reliability of aircraft engines, and on the other to the satisfactory development of rules of design." The Committee suggests that the relative immunity from accidents has been largely attained by the age-long process of trial and error, which has not been without its cost in loss of life. It is probable, however, that there is no other industry in applied science that has had quite so much scientific thought given to both its fundamentals and the elucidation of its errors in application of them. Hence the relatively rapid progress in both of the outlooks that the Committee considers has led towards safety is in itself due, in no small degree, to its own work.

Paradoxically, the report then discusses a series of accidents that have been happening to one particular type of aircraft, and admits that the trouble is not yet completely solved. Experiments on a model with specially made wings of the correct proportional elasticity are now in progress as an attempt to reproduce the apparent conditions under which these failures occurred. Such accidents cannot be entirely disassociated from existing weather conditions, and work has been undertaken in an attempt to measure such

* Aeronautical Research Committee. Report for the Year 1933–34. Pp. iv+89+4 plates. (London: H.M. Stationery Office, 1934.) 1s. 6d. net.

conditions in flight. The net result of the observations made suggests that only during one flight in 10,000 in western Europe is an aircraft likely to encounter disturbances in the air that would have an effect equal to meeting an upward gust with a velocity of 30 ft. per second. All aeroplanes as at present designed are strong enough to meet such a gust. This throws a sidelight upon the proportionate risk that is attendant upon flying. It would be interesting to compare it with the number of trips made by, say, a London motor bus, or a train on a British railway, per structural breakdown.

In a similar connexion, a reference is made to a report by the Director of the Meteorological Office on the effects of lightning on aircraft. In no instance has there been a fatality occurring as the result of a British aeroplane being struck by lightning, while damage to the structure is usually slight. This paper has been published by the Meteorological Office (Professional Notes, No. 66: Lightning and Aircraft. By G. C. Simpson. London: H.M. Stationery Office, 1934. 4*d*. net. See NATURE, Oct. 20, p. 618).

The spinning of aeroplanes has resulted in a number of accidents in previous years. Various ways of avoiding the dangers of a flat spin which sometimes arises during a normal spin, and from which it is difficult to recover, are mentioned in some detail. The new free spinning tunnel at the Royal Aircraft Establishment has been of considerable assistance in these investigations. In this tunnel, in which the air flows vertically upwards, a model can be left to spin freely and its behaviour observed. It is now considered that the problem is sufficiently understood to justify giving further experiments a lower priority than formerly.

A curious contradiction has arisen with regard to safety during landing and take-off. The increase in the wing loading and the general improvement in stream-lining of aeroplanes has increased the difficulties associated with these two manœuvres. It is possible under certain conditions to propel the aeroplane into the air by its own momentum before it is aerodynamically supported. The complete understanding of this problem and many others relative to control calls for a very thorough knowledge of the flow of air over wings in the stalled condition. This has been investigated principally at Cambridge. A picture of the air flow has been obtained by watching the behaviour of tufts of wool attached to the surface. When the flow is steady the tufts lie out along the wing, but when turbulent they wave about in a violent manner. This technique is proving useful for the study of air flow in many different ways.

Investigation into the properties of the autogiro has also been carried out during the past year. The new type, which is wingless and has no rudder or elevators, is considered to be a great advance on previous designs, especially from the point of view of safety in flight. It can not only land, but also take off in a very small space, and is particularly simple to control. Its minimum flying speed is about half that of a conventional type of aeroplane, and it is quite stable. For commercial purposes it may not be so efficient as the aeroplane. The Committee states that it is now examining the theory of the autogiro in more detail in order to find out whether there are any unusual conditions of flight when it may become unstable and dangerous.

The Committee has also considered proposals for the construction of cyclogiros or paddle-wheel aeroplanes. The outstanding problems on these aircraft are, in its opinion, that of difficulty of construction with reasonable weight rather than aerodynamics.

With regard to the work on aero-engines, the most promising lines of advance seem to be in single-sleeve valve engines; an illustration in the report shows the remarkable decrease in the number of parts to a sleeve valve cylinder of a radial air-cooled engine compared with the more normal design with a poppet valve cylinder. Work is proceeding also on compression ignition engines of the sleeve valve type. Consideration is being paid to possible replacement of carburettors in petrol engines by injection pumps, although there does not appear to be any fundamental advantage in the latter.

Lubrication is also mentioned, although with no very definite proposals up to the present. The difficulties of laying down a specification for a good lubricating medium are appreciated, not the least of these being to find out exactly what functions the engine user demands of the lubricant. Experiments have shown that the use of 'inhibitors' will delay the formation of gum on cylinders and pistons, and it is hoped to prevent the formation of sludge by similar means.

Certain progress is mentioned in the metallurgy of those metals of interest to the aeronautical engineer. The subjects investigated include elasticity and fatigue, the use of beryllium, magnesium alloys, corrosion prevention, etc.

A supplement of about seventy pages gives details of the year's work in aeronautical research under individual sub-headings as follows:—(i) Aerodynamics; (ii) fluid motion; (iii) stability and control; (iv) servo controls; (v) spinning; (vi) seaplanes; (vii) atmospheric turbulence and meteorology; (viii) structures; (ix) aircraft noise; (x) engines; (xi) elasticity and fatigue; (xii) alloys.

Obituary

Prof. Willem de Sitter

ASTRONOMY has suffered a heavy loss by the death of Willem de Sitter, director of Leyden Observatory. In the development of astronomical research in the present century, Holland has taken a conspicuous part; and, since the death of J. C. Kapteyn, de Sitter has been the leading astronomer of his nation. He is most widely known as the propounder of the 'de Sitter universe', a recondite development of the theory of relativity which is the basis of our present idea of an expanding universe. But that reveals only one side of his versatility. The great research, which occupied him for thirty years, was in classical celestial mechanics; and in 1931 the Royal Astronomical Society awarded him its gold medal "for his theoretical investigations on the orbits of the satellites of Jupiter, and for his contributions to the Theory of Relativity". It is a strange chance that, of his most conspicuous contributions, one should relate to the Jovian system—first-fruits of the invention of the telescope—and the other to the remotest systems that the telescope has yet revealed. But, setting aside his personal research, astronomers more usually think of him as the energetic head of a flourishing observatory, who by his sound practical judgment, his wide experience, and his single-minded character, has had a far-reaching influence on the general advance of astronomy.

Willem de Sitter was born at Sneek in Friesland on May 6, 1872. He was educated at the Gymnasium at Arnhem, where his father was a judge, and at the University of Groningen. Though primarily a mathematician, he was captured by Prof. Kapteyn's enthusiasm and began to work in the Astronomical Laboratory at Groningen. It was, however, Sir David Gill who finally converted him into an astronomer. Visiting Groningen in 1896, Gill made his acquaintance, and eventually invited him to the Cape to assist in the discussion of the heliometer observations of Jupiter's satellites. De Sitter found the Jovian system a subject after his own heart; it gave scope both to his mathematical training in celestial mechanics and to his later interests in the practical side of astronomy. He worked at it more or less continuously until 1929, when at last he felt satisfied to publish his definitive values of the orbital elements and masses of the four satellites.

After two years at the Cape Observatory, de Sitter returned to Groningen and became an assistant in the Astronomical Laboratory. In 1908 he succeeded H. G. van de Sande Bakhuyzen as professor of astronomy in Leyden. On the death of E. F. van de Sande Bakhuyzen in 1918, he was appointed director of the Leyden Observatory. This was an important and arduous post, for the Dutch Government had decided on a great enlargement and reorganisation. Leyden is one of the oldest observatories; its third centenary was celebrated last year; but for many years it had ceased to be an important institution. De Sitter applied himself to the reorganisation with energy and far-sightedness, and sacrificed his personal work to the responsibilities of his office. Surrounding himself with a well-chosen staff, he rapidly made the Observatory one of the most important in Europe. This success was fittingly recognised when he was made president of the International Astronomical Union for the period 1925–28.

One interesting innovation was the alliance which de Sitter formed in 1923 with the Union Observatory at Johannesburg, providing for regular visits of members of the Leyden Observatory to gather observational material in the favourable climate of South Africa. Leyden will shortly have its own instrument installed at the Union Observatory, namely an equatorial with twin photographic telescopes of 16-inch aperture having Cooke triplet objectives. The instrument is now ready for testing, and de Sitter was planning just before his death a visit to England to inspect it.

In 1916–17, de Sitter published a series of three papers in the *Monthly Notices of the Royal Astronomical Society* "On Einstein's Theory of Gravitation and its Astronomical Consequences". These were the first papers in English on the new theory. Einstein's original paper was almost inaccessible here, owing to the interruption of international communication; probably the only copy in England was one which de Sitter kindly sent to the present writer about this time. There were already a number of developments to be added. De Sitter's papers included an admirable up-to-date exposition of the mathematical theory; and they have greatly influenced the form in which the general theory of relativity has come to be understood in England. In the second paper, he investigated the effect of the new law of gravitation on the motion of the moon, and found that it would cause an advance of the perigee and node amounting to nearly 2″ per century; this is at present just outside the limits of practical detection. The analysis in the paper is very arduous, and shows how fully de Sitter had entered into the methods of the new theory. A simpler way of handling the problem has since been discovered, but it confirms de Sitter's conclusion.

It is in the third of these papers that the 'de Sitter universe' appears as a suggested alternative to the 'Einstein universe'. It is perhaps necessary to explain how these ideas arose. It has become the regular procedure in mathematical physics to express the laws of Nature by differential equations. But in classical physics at least the differential equation is not the whole of the law; boundary conditions are also prescribed. Thus it is not sufficient to say that Newton's law of gravitation is $\nabla^2\varphi = -4\pi G\rho$; there is the further condition that that solution of the differential equation must be taken which makes φ zero at infinity. Tested by the principle of relativity, the Newtonian equation failed; Einstein had to substitute another differential equation, and so reached his famous theory. But what is sauce for the goose is sauce for the gander, and the boundary values at

infinity should also be tested by the same principle. Unfortunately, they did not satisfy the test. In particular, the familiar solution giving the gravitational field of the sun (which affords the chief observational tests of the theory) gives values at infinity which are open to this criticism. Einstein was the first to recognise this inconsistency, and proposed a remedy. De Sitter pointed out that there was an alternative which in some ways appeared less artificial. He entered into a full discussion of the astronomical phenomena which might be used to discriminate between them. Both theories lead to a closed spherical space, and de Sitter's paper contains estimates of upper or lower limits to the size of the universe on either hypothesis. It is a reminder of our progress in the last seventeen years that none of these estimates is large enough to include some of the nebulæ the distances of which have recently been measured.

De Sitter pointed out that the most definite test would be provided by the velocities of the spiral nebulæ. In his cosmology, but not in Einstein's, the velocities should increase with increasing distance. He does not seem to have noticed that the velocities should all be recessive, though this is almost immediately evident from his formulæ. It is true that he predicted a systematic displacement of spectral lines to the red, due not to genuine motion but to a 'slowing down of time' at great distances from us. This is now recognised to be only a second order effect, and is submerged in genuine increase of receding velocity with distance. We need not here trace in detail how the present version of the expanding universe differs from de Sitter's original account; the differences are such as naturally arise in the course of development of a highly original idea. Confronted for the first time with the topsy-turvy conceptions to which his pioneer work had led, de Sitter was amazingly far-sighted on some points and amusingly blind on others. He appreciated as much as anyone the joke that some of the most surprising properties of his universe arose from the fact that he had forgotten to put any matter into it.

The de Sitter universe attracted the attention of geometers as well as physicists, and became a favourite theme of study. De Sitter took little part in this himself. By the time the radial velocities of spiral nebulæ had been determined in sufficient numbers, he was heavily occupied in reorganising Leyden Observatory. For at least ten years he was "the man who discovered a universe and forgot about it". But in 1930, having at last completed his work on the Jovian system, he returned to the subject. Learning later of Lemaître's development of the theory, he accepted it with enthusiasm and published a number of papers on the problems raised. An interesting summary of his later views is given in the last chapter of his book "Kosmos", which contains the Lowell lectures delivered by him at Boston in 1931.

Astrophysics, as ordinarily defined, was outside de Sitter's range; but he took care to secure in his observatory a strong astrophysical department directed by Prof. Hertzsprung. His activities included most other branches of astronomy—dynamical, statistical, instrumental. He did much work on the fundamental constants of the solar system. His work on Jupiter's satellites led him to contribute to the examination of the secular retardation and irregularities of the earth's rotation, using the early observations of these satellites to check the earth's performance as a time-keeper.

Both for his ability and his character, de Sitter was highly esteemed by his colleagues. He was a frequent and welcome visitor to England. He attended and took part in several meetings of the British Association, including the two meetings held at the Cape. He was far from robust, having suffered a long and severe pulmonary illness about 1921 which left him with a damaged lung; but he did not spare himself in activity. He looked older than his years. Outside astronomy he was much interested in art and literature; but his greatest joy was in his home life with his children and grandchildren. He had two sons and two daughters, all married.

On November 9 of this year he became seriously ill with pneumonia, at the same time with two other members of his family—a son and grand-daughter who had just returned from the Dutch Indies. The child died on November 16, but it was hoped that de Sitter would recover. On November 18, complications set in and he grew rapidly weaker. He died on November 19.

A. S. E.

The Rev. A. H. Cooke

ALFRED HANDS COOKE was born at Enfield in 1854. He was a colleger at Eton and proceeded as a scholar to King's College, Cambridge. Here he crowned a classical career of unusual brilliance by being Senior Classic in 1878. The following year he was elected a fellow of King's, where he remained as dean and tutor until 1900.

Cooke's scientific work was almost exclusively confined to the study of the Mollusca, and in this branch of zoology he soon attained a position of widely recognised authority. He was University curator of zoology from 1881 until 1890 and in 1895 published his best-known book—the entirely charming volume on Mollusca in the Cambridge Natural History. But he did much other work of a more technical nature and the value of his many papers on conchology was acknowledged by the degree of Sc.D. conferred on him by the University in 1914. He was president of the Malacological Society in 1913–15 and of the Conchological Society in 1919–20. His large collection of shells, many of them taken by himself in foreign travel, he had recently presented to the British Museum. This collection includes a very long series of the whelk, *Purpura lapillus*, from all parts of the world. It shows the extreme variations of the species and contains a sinistral variant, a Hungarian specimen and one of the four or five recorded examples.

For twenty years after leaving Cambridge, Cooke was headmaster of Aldenham, where he produced a steady stream of fine classical scholars of his own training, and continually encouraged and extended

the teaching of science. He was an impressive preacher and an exceptionally fine lecturer, and to many generations of his boys the memory of his personality will ever remain one of the most powerful influences of their lives.

Cooke was, indeed, one of the really great men who touched nothing that he did not adorn. He had no mean reputation as a classical scholar and his dual record—Senior Classic and Doctor of Science of Cambridge—must be unique. In 1920 he retired to the Eton living of Mapledurham, where, attracted to the study of archæology, he quickly mastered a new subject and produced, in 1925, his fascinating book, "The Early History of Mapledurham". It was here that he died on November 28. T. H. S.

WE regret to announce the following deaths:

Dr. Aristarch Belopolsky, vice-director of the Central Astronomical Observatory, Pulkovo, U.S.S.R., on May 16, aged eighty years.

Prof. O. D. Chwolson, formerly professor of mathematical physics in the University, Leningrad, on May 11, aged eighty-two years.

Dr. J. W. Leather, agricultural chemist to the Government of India in 1892–1916, on November 14, aged seventy-three years.

Dr. Theobald Smith, For.Mem.R.S., formerly director of the Department of Animal Pathology of the Rockefeller Institute of Medical Research, New Jersey, aged seventy-five years.

News and Views

Charles Augustus Young (1834–1908)

AMONG the many eminent American astronomers of last century, few were better known than Charles Augustus Young, the centenary of whose birth occurs on December 15. As a pioneer of solar spectroscopy, he was second to none, while his great gifts as a writer and teacher gained for him a world-wide reputation. Born at Hanover, New Hampshire, where both his father and grandfather had held chairs in Dartmouth College, he graduated in 1853, and then after a tour in Europe with his father, for a few years taught classics and theology. At twenty-three years of age he was made professor of mathematics in Western Reserve College, Ohio, and from that time onwards devoted himself to astronomy. The Civil War for a short time interrupted his work, but in 1866 he succeeded his father in the chair of astronomy at Dartmouth College, and eleven years later succeeded Alexander as professor of astronomy at Princeton, a position he held until his retirement in 1905. Although he made investigations of the spectra of the planets, comets, stars and nebulæ, his main interest was in solar investigations. He observed total solar eclipses at Burlington, Iowa, in 1869, at Tenez de Frontena, Spain, in 1870, at Denver in 1878, in Russia in 1887 and in North Carolina in 1900. It was in connexion with the eclipse of 1870 that he made his striking discovery of the so-called 'reversing layer'. He observed the transit of Venus of 1874 at Peking and that of 1882 at Princeton. His well-known book "The Sun" appeared first in 1881, while later he published his "General Astronomy", 1889, "Elements of Astronomy", 1891 and "Manual of Astronomy", 1902. His book on "The Sun" passed through many editions and was translated into several languages. Honours came to him from England, Germany, Italy and France, and in 1891 he was awarded the Janssen Medal of the Paris Academy of Sciences. In 1882 he served as president of the American Association for the Advancement of Science. He died at Hanover, New Hampshire, on January 3, 1908, at the age of seventy-three years.

Present-day Scientific Research

SIR JAMES IRVINE, principal of the University of St. Andrews, in replying to the toast of the profession of chemistry at the Ramsay Chemical Dinner held in Glasgow on December 7, gave his views on some aspects of modern research. Sir James reviewed the changes which have taken place in chemical industry since the beginning of the century and referred particularly to Scotland. He said that a country which produced men like Neilson, Young, Tennant, Townsend and Watt appeared to have nothing to fear from changes in industrial conditions. But the new conditions have formed themselves too quickly, and their impact on a disorganised world has been too swift for readjustment to be entirely satisfactory or even possible. In regard to scientific training, Sir James finds himself at variance with the spirit of the times because he cannot resist the thought that scientific training in Great Britain is already over regimented. He did not refer particularly to undergraduate instruction but more to the extreme specialisation and almost mechanical quality of much of the work termed research. The ladder of research was once difficult of access and steep to climb. Only the zealots made the attempt, impelled by a force they could not control, and only the strongest survived. To-day no training is reckoned complete on first graduation, and in consequence research students, sometimes singly, more often in teams, work towards the goal of a higher degree.

SUCH a form of research is a costly business: it is time-consuming, and the penalties fall on those who ought to be spared. Advances in science are certainly made, but Sir James is concerned chiefly with the effect of such work on the individual and the stultification it begets in his power to think. Many students at present engaged in research would be infinitely better employed in supplementing their academic knowledge by a training in the methods whereby science is operated in industry and in the conduct of the practical affairs of life. Many professors, too, would be better professors and capable of greater

service to the world if they were allowed the leisure and peace of mind to prosecute their researches unhampered by the care and training of research collaborators. The methods of the solitary philosopher, the methods of Davy and Faraday, can scarcely be excelled. Research in the academic sense has become a fashion; it will soon become a trade and then farewell to the hopes that Great Britain will again produce the few particular men who, in a flash of genius, have turned discovery into invention and invention into industry. Scotland has given to the world such pioneers, and is not lacking in the qualities which are needful.

Reduction of Working Hours in Industry

THE uncompromising attitude of certain sections of British industry to proposals for the reduction of working hours might be regarded with some amusement but for the serious results which it is likely to precipitate. The portentous arguments set forth, for example, by the National Federation of Employers Organisations against the forty-four hour week recapitulate in unmistakably the same accents those advanced with equal plausibility in previous generations against Factory Acts, the abolition of child labour and the limitation by law of the hours of work by women and children. There are, however, important firms such as Imperial Chemical Industries, Ltd., in its Billingham Works, and Boots Pure Drug Co., at Nottingham, which have had the courage and wisdom to determine the possibilities of the forty-hour or five-day week by direct experiment. The experiment carried out at Nottingham is of the greater interest in that its results have been made generally available in an important report by Sir Richard Redmayne, who was nominated by the Ministry of Labour, at the firm's request, to conduct an exhaustive inquiry as to whether the permanent adoption of the five-day week in all its works is possible ("A Review of the Experimental Working of the Five Days Week by Boots Pure Drug Company at Nottingham." By Sir Richard A. S. Redmayne. Pp. 70. Nottingham: Boots Pure Drug Co., 1934. 1*s*.). The publication of the full details of this investigation in itself constitutes a noteworthy break with the tradition of secrecy which has hampered the pooling of experience in matters of industrial safety, hygiene, labour policy, etc.

SIR RICHARD REDMAYNE concludes that the working of the five days working week inaugurated on April 30, 1934, and terminating on September 29, has proved an unqualified success both from the business point of view and from that of the employees. He is satisfied that the cost in the aggregate has not been enhanced and the efficiency of the employees has been increased. Marked improvements in health, contentment, regularity of attendance at work and diminution of absenteeism have been observed since the start of the experiment, and the employees themselves would view with dismay any return to the five and a half day week. Had the working hours per week not been reduced, it would have been necessary to discharge a number of workers, and from this point of view alone the experiment has already been of real benefit to the community itself. Sir Richard Redmayne is satisfied that equally satisfactory results would be obtained if the experiment was continued over the winter months. It is, of course, difficult to say how far the experiment can be applied to other concerns with equal prospects of success. The intimate relation of production and distribution in this particular concern has probably contributed largely to its success, but Sir Richard Redmayne considers that there are many works at which the five day week might be tried with equal prospects of success. Messrs. Boots have set an example in scientific experiment on a most important social-industrial question, and scientific workers should not be slow in pointing out to the community the possibility of obtaining similar decisions in these matters in other industries or concerns.

Rare Books on Magic

AN exhibition of old and rare works dealing with magic, witchcraft, legerdemain and kindred subjects was opened on December 6 and was on view until December 14 at the University of London Council of Psychical Investigation, 13D Roland Gardens, South Kensington, London, S.W.7. Five hundred items had been selected for exhibition out of the 12,000 volumes collected by Mr. Harry Price, the honorary secretary of the Council, forming what is probably the largest and most important assemblage of printed works relating to occult subjects available for the student. The books exhibited ranged in date from about 1490 to the present day, though, curiously enough, the "Malleus Maleficarum" (1488), the first printed work on witchcraft, and the Bible of the witch finder, was not represented by a copy earlier than 1576. Works dealing with magic and the witch, ghosts and spiritual manifestations generally, of the sixteenth, seventeenth and early eighteenth centuries are becoming increasingly rare and expensive, and many of them in a few years' time will be unobtainable. A specialised library of the size of that of the Council for Psychical Investigation is, therefore, of great importance for the psychologist and the social historian. In looking through any extensive range of books such as this, it is significant to note how slow has been the growth in appreciation of the nature of evidence when any element of the supernatural has been implicated in an investigation. Although early works, such as Lavater's "Ghostes and Spirites Walking by nyghte . . ." (1572) and Scot's "The Discoverie of Witchcraft" are thoroughly sceptical, it was not until 1668, in the work of the Rev. Joseph Glanville, fellow of the Royal Society and virtually the father of psychical research, that anything in the nature of a systematic setting out of evidence was attempted.

THE recent haunting at Saragossa, in which voices in a chimney have been explained as due to the "unconscious ventriloquism" of a serving maid—an explanation almost as mysterious as the phenomena it explains—adds interest to the accounts in this

exhibition of remarkable manifestations associated with the youth of both sexes from time to time. Eventually they have, as a rule, been attributed to imposture. Among the best known is the Cock Lane Ghost in the middle of the eighteenth century, which inspired one of Andrew Lang's more intellectually agile efforts and is represented in the exhibition by an anonymous pamphlet attributed to Oliver Goldsmith. Another case, equally famous, if more materialistic in its supposed manifestation, was that of Mary Toft (1726) who gave birth to 27 rabbits, but failed to be equally prolific when removed from Guildford to Leicester Fields. In tracing back the history of the investigation of spirits, and of trials for witchcraft, it is remarkable what degree of credence was given to the evidence of juvenile neuropaths, and how frequently it was accepted as adequate, often without corroboration, to ensure condemnation of the accused to prison and death, while at the close of the sixteenth century the case of one Somers discussed in "A Discovery of the Fraudulent Practices of John Darrel . . ." by Samuel Harsnett, an eminent divine and later Archbishop of York, was near to causing a schism in the Church.

Exhibition of Antiquities from Colchester

A SPECIAL exhibition of antiquities from Colchester opened at the British Museum on December 10. The objects exhibited illustrate the results of the five years' exploration carried out on the British and Roman site at Colchester by the Colchester Excavation Committee, which was formed in 1930 by the British Museum and the Essex and Colchester Museum jointly. The exhibits, which consist of objects obtained by excavation, and plans, drawings and photographs, while giving a general view of the results, serve particularly to illustrate three aspects of the information which five years' work has made it possible to piece together. The first of these is the history of the site, beginning with its first foundation as a British city, then in its period of greatest prosperity under Cunobelinus (A.D. 5), its conquest at the time of the invasion of Claudius (A.D. 43), and its eclipse on the rise of the Roman city seven years later. Apparently the diminished British city shared the fate of the Roman city when the latter was burned by Boudicca in A.D. 61. The photographs of the structural remains discovered and their plans, as well as the series of coins and material remains, are an index of the vicissitudes of the site. The second aspect is the character of native culture at Camulodunum; and the third, the effect of the impact of Roman culture on that of the native. To some, this last will appeal as of the greatest interest of all. Many new facts, indeed, have been brought to light at Colchester, not the least important being the data bearing upon the manufacture of Romano-British pottery. The remarkable discovery of the now famous kiln demonstrated that not only did the Romano-British potters make jugs, mortars, etc. in buff ware, slip coated fabric, castor ware, etc., but they also made the well-known Samian or 'terra sigillata' of which the manufacture had previously been thought to be confined to Gaul.

Archæological Investigations in Ireland

DR. O'NEILL HENCKEN, director of the Harvard Archæological Mission to Ireland, before leaving for a brief vacation in America, has given an account of the results achieved in the recently completed third year of the Mission's work, which appears in the *Observer* of December 9. Excavations at Cushenden, Co. Antrim, would seem to have confirmed fully the view of the importance of this site for the elucidation of the origin and affinities of the stone age industries of north-east Ireland, which is held by Mr. C. Blake Whelan, with whom the Mission has been in co-operation. Mr. Whelan has recently pointed out the probability that further systematic investigation of stone age sites in this area would provide evidence of stratification, which is lacking for certain of the comparable European industries of the mesolithic and earlier phases of the neolithic ages (see NATURE, Nov. 4, p. 702). From Dr. Hencken's statement, it now seems that this evidence is likely to be forthcoming from Cushenden, when certain comparative studies now in progress have been completed. He states that all the phases of the Irish stone age have been found at Cushenden in conditions, geological and other, which should provide the necessary data for the discussion of the origin of these cultures and their affinities with comparable material from sites in Britain and on the Continent.

DR. HENCKEN also referred to the Mission's investigations on the crannog site of Lagore, Co. Meath, known from the annals to have been the residence of Irish kings in the eighth, ninth and tenth centuries. The excavations have shown that the site was occupied from much earlier times and have brought to light a wealth of material illustrating Irish culture in earlier centuries. The crannog is 150 ft. in diameter and 11 ft. thick. It was surrounded by an oaken palisade. The lake in which it stood has now disappeared. The inhabitants were pastoralists, but practised occasional hunting. Few, if any, traces were found of agricultural activity. Ornaments of bone and objects of leather, predominating in number, bear this out. Other materials in use were bronze, iron, glass (beads), enamel, wood, stone and pottery. The Mission has received generous assistance from the Irish Government.

Medical Uses of Radium

A REPORT bearing the above title has been issued by the Medical Research Council summarising the results of research work during 1933 in the treatment of cancer and other conditions (Spec. Rep. Series, No. 197. H.M. Stationery Office. 9*d*. net). The radium is lent by the Council to selected centres throughout Great Britain, and these furnish reports to the Radiology Committee. In cancer of the mouth, radium has proved a successful agent in the treatment of primary growths of the tongue, but when the glands are involved they are much less amenable.

With breast cancer, operation is generally successful in early cases, but when the axilla is involved, much less so. For the latter, radium therapy has been extensively tried with questionable success, and X-rays are probably a more suitable agent. In uterine cancer, frankly operable cases are treated as successfully by radium as by surgery, but with a smaller operation mortality, and surgically inoperable cases treated by radiation yield a by no means negligible percentage of clinical cures. Certain non-malignant conditions also respond well to radium treatment, for example, uterine hæmorrhage. Several important experimental researches are also included in the report.

IT is estimated that the total quantity of radium available for treatment in Great Britain is now about 70 gm. Of this amount, the Radium Commission controls 23 gm., which includes 20 gm. placed at its disposal by the Radium Trust, and three 1 gm. units, the property of the King Edward's Hospital Fund (Fifth Annual Reports of the National Radium Trust and Radium Commission 1933–1934. H.M. Stationery Office. 9*d.* net). The radium is distributed for use for experimental work and treatment between the Medical Research Council and the National Physical Laboratory, certain London hospitals and institutions, and thirteen national radium centres and five regional radium centres. In addition, allocations have been made by certain organisations, such as the British Empire Cancer Campaign, and a considerable amount of radium is privately owned.

National Medical Statistics

THE Registrar-General's Statistical Review of England and Wales for the Year 1933 (Tables, Part 1: Medical), pp. iv+406, has recently been published (London: H.M. Stationery Office. 6*s.* net). It appears that the number of births registered in 1933 was 580,413, giving a rate of 14·4 per 1,000 persons living. This rate is 0·9 below that for 1932, and constitutes a new low record. The death-rate was 12·3 per 1,000 persons living, 0·3 above the rate for 1932 (the same as that for 1931) but 0·9 above that for 1930. The deaths of children under one year of age numbered 64 per 1,000 live births against 65 in 1932, 66 in 1931 and 60 in 1930. Cancer showed a death-rate of 1,526 per million persons living against 1,510 in 1932. If, however, allowance is made for differences in the age constitution of the population, the comparative mortality from cancer shows a slight decrease. Tuberculosis again furnished a new low record of 824 per million living. Puerperal sepsis caused the deaths of 1·75 women per 1,000 live and still births, 0·20 more than the rate for 1932 but 0·09 less than 1930. The death rate from suicide was 140 per million persons living, a decrease of 3 per million on the record high rate of 1932. A slow increase in this rate had been continuous for a number of years. Road accidents due to mechanical vehicles were responsible for 5,934 deaths. The figures for the last five years were 5,196, 5,752, 6,342, 5,892 and 5,671 respectively.

Exhibition of Microscopes

THE second annual exhibition of microscopes and appliances, conducted by Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C., which has been open all this week at the Central Hall, Westminster, attracted numerous visitors. A number of mounted specimens were shown on a series of microscopes ranged round the Hall, comprising diatoms, pollens, histological and pathological specimens, and crystals with polarised light. Members of the Quekett Microscopical Club arranged an interesting exhibit of living pond-life, including some beautiful specimens of *Volvox* and *Vorticella*. The use and value of the microscope in industry were demonstrated by exhibits illustrating the differences in microscopic structure of various qualities of leather, the size of sugar crystals, cocoa particles and entangled air bubbles as influencing the quality of sweets in confectionery, and the microscopic flora in cheese and in vinegar fermentation. A side-show of considerable interest was a demonstration of the making of the glass discs and their shaping, grinding and polishing so as to form the constituent lenses for microscope objectives. Other exhibits illustrated the detection of forgery and of crime weapons, and formed the subjects of two of the lantern lectures, by Mr. T. J. Ward and Major G. Burrard respectively, which have been a feature of the exhibition. Other lantern lectures included "A Naturalist on the Amazon" (Mr. Robins), "An Amateur among the Stars" (Mr. Offord), and "How Lenses are Made" (Mr. Watson Baker), together with several cinematograph displays by the Kodak Company.

Sound and Noise

A RESEARCH and Development Lecture on "Sound and Noise" was given at the Royal Institution on December 12, under the auspices of the Institution and the British Science Guild, by Dr. G. W. C. Kaye, Superintendent of the Physics Department at the National Physical Laboratory. Mr. Hore Belisha, the Minister of Transport, was in the chair. Man has developed very many and ingenious ways of making sounds and noises. In some everyday events the noise is only a small by-product; for example, only about a thousandth part of the energy of a dropped weight or of a hand-clap appears in the form of noise. This figure was increased to a few per cent in the case of motor horns and loud speakers, and even up to 30 per cent or more for the loud speakers used for talking pictures. By comparison with many sounds, the human voice is very weak, and even during shouting the output was only about 0·001 watt. Suitably equipped, an orchestra of 75 has a normal acoustic output of about 0·5 watt, which in strident passages may be increased 100-fold—quite enough, if it could be so applied, to light an average electric lamp.

FOR the purposes of the measurement of the loudness of noise, a reference standard of sound has been chosen, which consists of a pure note of a frequency of 1,000 cycles per second. The adjustable

intensity of the standard note is measured on a scale of decibels above an arbitrary zero near the threshold of hearing; the corresponding loudness is then expressed on a numerically identical scale of phons. The various subjective noise meters on the market determine the equivalent loudness of noises in phons by matching them by ear against the standard note. The objective meters, on the other hand, depend on the physical measurement of the intensity by a microphone; they can, however, be made to stimulate the ear and so compare the loudnesses of similar noises. The new acoustics laboratory at the National Physical Laboratory has greatly facilitated investigatory work on the steps required to reduce sources of noise, on the noise proofing of walls and on the noise absorption of building and other materials. The last line of defence against noise in a building is the use of surface absorbents. Ordinary hard plaster is a better reflector of sound than a mirror is of light, so that in modern rooms designedly free from curtains, upholstery and carpets, the noise level can become uncomfortably high unless one of the commercially available acoustic absorbents is applied to the walls or ceilings.

Experimental Hand-Rearing of Game Birds

ORNITHOLOGISTS and students of game birds have become increasingly interested in experiments in hand-rearing and introducing game birds to new areas, and what is believed to be the first ptarmigan (*Lagopus leucurus*) to hatch in captivity was from one of eighteen eggs collected by Dr. A. A. Allen, of the Department of Ornithology of Cornell University, near Churchill, Hudson Bay, and put under bantams at Ithaca (*Scientific American*, Nov. 1934). Science Service, of Washington, D.C., reports that a second batch of twenty ptarmigan eggs has been obtained from Canada and put under bantams, though several eggs have been broken by the foster mothers. During the present year, the first introduction, and hatching, of English pheasants (*Phasianus colchicus*) in Uganda was accomplished by the Agricultural Department at Kamala (T. W. Chorley, *Field*, Aug. 4, 1934). The eggs were obtained by Mr. T. W. Chorley, of the Agricultural Department in Uganda, from the Silverdale Game Farm, Lancashire, and arrived by air mail on May 3. Next day they were put under two native fowls, and three chicks hatched on May 27, and the remainder on May 28, 85 per cent of the imported pheasant eggs hatching. Unfortunately, two heavy storms broke out in the first three weeks, and several birds died, but the remainder did well.

Electricity on Board Ship

THE paper read by C. W. Saunders, H. W. Wilson and Dr. R. G. Jakeman to the Institution of Electrical Engineers on November 22 on the generation, distribution and use of electricity on board ship is a timely one. Although electricity was used in the British Navy for various purposes so far back as 1874, it is only since the advent of the Diesel engine that it has been largely used. To-day, almost all auxiliary machinery—from the windlass in the bows, through the engine room and hull, to the steering gear in the stern—is electrically operated in important ships. In a 20,000 ton turbo-electric passenger liner, the propelling machinery, usually two turbo alternators, would be about 20,000 horse power and there would be usually four motors to which they send the power. In addition, there would be four main generators each of a 1,000 h.p. The steering gear requires 84 h.p., the capstan machines 536 h.p. and the boat davits 120 h.p. For the fans 500 h.p. is required and for the refrigeration 290 h.p. Compared with these numbers, the 31·5 h.p. required for the passenger lifts seems small. A modern liner is really a large floating hotel, and when at sea the travelling public demands a standard of comfort as high as that obtainable on the best hotels ashore. Consequently the most modern types of lighting, heating and cooking equipment are installed. The galley alone at times of maximum load may require 900 h.p. In the *Queen of Bermuda*, for example, there is one 450-line telephone board, 250 electric signs, 2,250 bell pushes, 400 electric radiators, 650 electric fans for cabins, 410 miles of conductors in cables and wires and 20,000 electric lamps. For very large ships it is generally agreed that turbo-electric drive is the most suitable at the present time.

De la Beche's "Researches in Theoretical Geology"

PUBLISHED in 1834, unpretentious in size and style (12mo.), De la Beche's work was especially welcome to the younger geologists of the time as a philosophical treatise, comprehensive and helpful in design. This little volume had an interesting preface explaining the author's position. It ran as follows:—"Although the theory of central heat and the former igneous fluidity of our planet have been much dwelt upon in the following pages, the author trusts that he will not be considered so attached to these views as not to be ready to reject them and embrace others which may afford a better explanation of an equal number of unobserved facts. . . . It can only be amid a thousand errors, and by a determination to abandon our preconceived opinions, when shown to be untenable, not by pertinaciously adhering to them . . . that we can approximate towards the truth. By strictly advocating a particular theory, prominently displaying those facts only which may appear to afford it support, we are in perpetual danger of deceiving ourselves and others." Finally—"We may conclude that whatever changes our planet may suffer, either from external or internal causes, and the necessary conditions exist, life will be created to suit those conditions; even after man, and the terrestrial animals and plants contemporaneous with him, may have ceased to live on the surface of the earth."

Proceedings of the Fifth Pacific Science Congress

IT is hoped to publish very shortly the complete *Proceedings* of the Fifth Pacific Science Congress which was held at Victoria and Vancouver, Canada, in June 1933. The publication will be in five volumes:

(1) general and Congress symposia; (2) astronomy, geodesy and geography, geology and mineral resources; (3) meteorology and terrestrial magnetism, oceanography, radio, seismology and volcanology; (4) agriculture, anthropology, animal diseases and botany; (5) entomology, fisheries, forestry and zoology. The *Proceedings* will be published by the University of Toronto Press, Toronto, Ont., Canada, price 20 dollars.

Journal of Applied Mechanics

THE Applied Mechanics Division of the American Society of Mechanical Engineers will publish a *Journal of Applied Mechanics* beginning on March 1935. The technical editor will be J. M. Lessells, Swarthmore, Pa., U.S.A., who will have the assistance of several distinguished authorities on applied mechanics. The *Journal* will appear four times each year in issues containing about eighty pages each. It will consist of original papers in general mechanics, elasticity, hydrodynamics, aerodynamics, strength of materials and thermodynamics, similar to those published during the last few years in the *Transactions* of the Applied Mechanics Division of the Society. The price will be five dollars for non-members of the Society for annual subscription, to be sent to A.S.M.E., Applied Mechanics Journal Fund, 29 West 39th Street, New York, N.Y., U.S.A.

The Physical Society's Exhibition

THE twenty-fifth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on January 1–3 at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7. The leading manufacturers of scientific instruments will be exhibiting their latest products in the Trade Section. The Research and Experimental Section will contain contributions from most of the important research laboratories in Great Britain, and there will be a special sub-section devoted to experiments of educational interest. In addition, the work submitted for the craftsmanship competition by apprentices and learners will be on view. Discourses will be delivered each day at 8 p.m. as follows: January 1, Dr. B. Wheeler Robinson, "The Architecture of Molecules"; January 2, Dr. C. V. Drysdale, "The Problem of Ether Drift"; January 3, Dr. H. Spencer Jones, M.A., "Giant Telescopes". Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, S.W.7. No tickets will be required on January 3.

Announcements

MR. MERVYN O'GORMAN will read a paper entitled "Bringing Science into the Road Traffic Problem" before the British Science Guild at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on December 19, at 5 p.m. The paper will be followed by a discussion.

THE following appointments have recently been made by the Secretary of State for the Colonies: C. B. Gibbins, to be agricultural assistant, Coffee Experimental Station, Moshi, Tanganyika; S. G. Wilson, to be veterinary officer, Nyasaland; A. C. Shill, marketing officer, fruit and vegetable trades of the Leeward and Windward Islands, to be adviser in agricultural marketing and controller of agricultural exports, Malta; T. H. C. Taylor, late entomologist, Coconut Committee, Fiji, to be assistant entomologist, Agricultural Department, Uganda.

THE Royal Academy Exhibition of British Art in Industry will be opened on January 5 and will close early in March. In connexion with the Exhibition, a panel of lecturers has been organised who are prepared to visit schools, works, etc., to lecture on cognate subjects. Further information can be obtained from the Secretary, Royal Academy of Arts, Piccadilly, London, W.1.

IN the list of British representatives present at the opening of the Maison de Chimie in Paris (NATURE, Dec. 8, p. 868) it should have been stated that Mr. Edwin Thompson was present in his capacity as president of the Society of Chemical Industry.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in botany in the University of Western Australia—The Agent-General for Western Australia, Savoy House, Strand, London (Dec. 18). An assistant in the M.B. classes and in dental metallurgy at Guy's Hospital Medical School—Prof. C. S. Gibson, Guy's Hospital Medical School, London, S.E.1 (Dec. 19). A technical assistant in the War Department Establishment—The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18 (Dec. 19). A teacher of metallurgy at the Municipal Technical College, Coventry—The Director of Education, Council House, Coventry (Dec. 21). Two agricultural advisory officers to the Norfolk County Council—The Clerk, The Shirehouse, Norwich (Dec. 22). A lecturer in electrical engineering at West Ham Municipal College, Romford Road, E.15—The Principal (Dec. 31). A demonstrator in chemistry at King's College, Strand, London, W.C.2—The Secretary (Jan. 1). A professor of electrical engineering at the College of Engineering, Guindy, Madras—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Jan. 4). A University lecturer in zoology at the University of Cambridge—F. T. Brooks, Botany School, Cambridge (Jan. 7). A director of forestry in the Irish Free State—The Secretary, Irish Land Commission (Forestry), 24, Upper Merrion Street, Dublin (Jan. 31). An investigator for metallurgical research at Cambridge—Prof. R. S. Hutton, University Metallurgy Laboratories, Pembroke Street, Cambridge. A professor of hydraulic engineering and a professor of mechanical engineering at the National Chekiang University, Hangchow—Universities China Committee, 91, Gower Street, London, W.C.1. A junior investigator at the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Regnart Buildings, Euston Street, N.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 938.

A New Potato Epidemic in Great Britain

EARLY blight (*Alternaria solani*) of the potato has been observed in Great Britain in the field only but very rarely, and its attacks have not been known hitherto to assume epidemic proportions in Great Britain. In the autumn of 1932 several sporadic cases were noted in the experimental plots at Cambridge, whilst somewhat earlier a few of our plants in the glasshouse had been thought to be suffering from the same disease. At that time examination of the lesions had failed to demonstrate the distinctive spores. In 1933, the disease was considerably more common at Cambridge, and in the autumn of that year, Dr. Dillon Weston very kindly examined specimens and recovered from them an *Alternaria* in pure culture. Sub-cultures were submitted to Prof. Westerdijk of Baarn and to Mr. Wiltshire of the Imperial Mycological Institute, both of whom identified the species as *A. solani*.

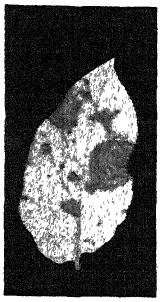

FIG. 1. Leaflet showing the rounded lesions and the concentric rings—the fusion of individual flecks is commencing.—Photo by infra-red light.

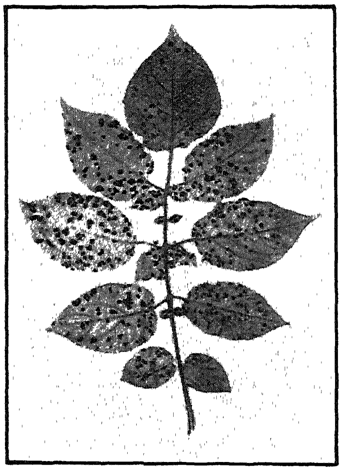

FIG. 2. An entire leaf of a Kerr's Pink plant representing the average condition of the disease in this variety in north-west Scotland towards the end of September 1934.

During 1934 we have succeeded in infecting a large number of seedlings, as well as several adult plants of established varieties both in the glasshouse and the field, and have had no difficulty in finding the spores on the lesions.

One of us had occasion to spend the month of September examining potato crops in the Outer Hebrides, the north-west coastlands, and in the great potato-growing areas of Ross, Cromarty and Aberdeen, and found that the disease—often in an advanced stage—was present throughout the whole area on every plant examined of the widely grown variety Kerr's Pink. Plants of the variety Edzell Blue were less heavily infected, whilst those of the variety Golden Wonder seemed to have escaped attack. A similarly widespread and intensive field infection was found in the late autumn in Cambridge on the varieties Majestic and King Edward.

In the United States, tuber damage is a common feature of the disease, but we have no evidence so far that the tubers have been affected in the field in Great Britain. It may be that the epidemic spread is correlated with the occurrence of the last two abnormally dry seasons, but against this it must be remembered that we first observed the disease in the field in the summer of 1932.

Apart from loss due to direct damage to the tuber, it is almost certain that a disease which destroys about 25 per cent of the green leaf area of the plant must cause a sensible reduction in crop, if only as a result of the loss of photosynthetic tissue.

It is obvious that we are now confronted in Great Britain with early blight in an epidemic form. This disease has long been a serious source of loss in various parts of the Continent, including Holland, and is regarded as one of the major potato diseases in the United States, where it is responsible in some years for a loss due to tuber infection in the neighbourhood of 25 per cent of the crop. On the Continent, in the United States, India and South Africa, the ravages of this disease have been held in check fairly satisfactorily by use of the Bordeaux spray or copper-lime dust.

REDCLIFFE N. SALAMAN.
CECILIA O'CONNOR.
Potato Virus Research Station,
Cambridge.

Longevity of Seeds

THE question of the longevity of buried seeds is always recurring, as witness the recent revival of the fable of 'mummy wheat'. There is abundant evidence that the embryo of the wheat grain perishes relatively soon, in ten years or less under ordinary conditions. Respiration goes on until the substance of the embryo is burnt away; extreme desiccation may prolong the process. Other seeds, however, do retain their vitality for much longer periods when dry, and when buried in earth germination may be indefinitely delayed. Possibly the tension of carbon dioxide in the soil gases slows down the respiration process; again, we have found that humus, particularly of deep-seated peat, contains substances inhibiting germination, even when the conditions of moisture, aeration and temperature are optimum.

This raises the fundamental question of whether the life of an organism can be suspended and pass into a static condition, to be resumed when the environment becomes favourable again. So far as our experimental knowledge goes, seeds are always respiring, considerably at first when they are drying off after ripening, but then more slowly, the machine just 'ticking over' as long as life remains.

If the essence of life resides in change, can there be a stop and a later resumption? On the basis of some continuing change, however minute, being necessary,

how are we to account for the long dormant life of some organisms that possess a very small reserve of respirable material, as for example the spores of bacteria which in the dry state have a very long recorded life ? Some refined experiment seems to be needed to try whether in such cases respiration, however infinitesimal, is not still going on.

This is not the only unsolved question that the dormancy of seeds presents. Every farmer and gardener is familiar with the growth of certain weeds, notably charlock, which follows the ploughing up of land which may have been in grass twenty or thirty years. But why in an ordinary arable field, subject to charlock, do we get a rush of growth in one year and few or no seedlings in another ? Why do other rare plants suddenly spring up in unexpected places ? In Dr. Brenchley's experiments on the germination of seeds contained in soils taken at different depths from the old Rothamsted plots, the soil samples are exposed to optimum conditions of aeration, moisture and temperature, but years elapse before all the seeds germinate.

In the past abnormal season many unexpected 'weeds' have appeared in the John Innes gardens. Some are comparatively uncommon plants, that as far as is known have never been grown here ; for example, *Datura sp.*, *Ambrosia artemisiaefolia*, *Physalis edulis*, etc. It may be supposed the seed had been introduced in manure, but considering the rarity of the plants, that only shifts the locality of the problem. One piece of land here, after it had been cleared from sweet peas, has covered itself with *Nicotiana* seedlings. Nine years earlier the plot had carried *Nicotiana*, but in the intervening period not a seedling had been seen. We know something of the effects of 'vernalisation' and of chilling in stimulating the germination of certain seeds which may otherwise refuse to start, but this dormancy of buried seeds still offers problems for experiment.

A. D. HALL.

John Innes Horticultural Institution,
Merton, S.W.19.

Kinetics of Photosynthesis

I AM grateful to Emerson and Green[1] for directing attention to the fact that the equation expressing the velocity of photosynthesis during the photostationary state[2] was incorrect because it indicated that the temperature coefficient is a function of the external CO_2 concentration. Their alternative formula is open to the same criticism, since it indicates that the temperature coefficient increases with decrease in CO_2 concentration. The error is due to an incomplete definition of the conditions which govern the photostationary state.

There are three processes involved ; namely, the primary light reaction in which the chlorophyll in its complex with CO_2 undergoes a change, the Blackman reaction in which this changed chlorophyll is restored to its original state, and the formation of the complex of chlorophyll with CO_2. If the velocities of these three processes be equated to give the expression for the photostationary state, the resulting expression indicates that the rate of photosynthesis in flashing light is independent of the external CO_2 concentration, which is known not to be the case. If, however, the assumption be made that the rate of formation of the complex with CO_2 is very fast in the case of the chlorophyll formed in the Blackman reaction, and that the establishment of the equilibrium between ordinary chlorophyll and CO_2 is slow, the equation for the photostationary state is simplified to

$$y = k_1 I(bA - x) = k_2 x e^{-Q/RT}$$

whence

$$\log \frac{y}{K - y} = \log \frac{k_2}{k_1 I} - \frac{Q'}{T},$$

where A is the total concentration of chlorophyll in the irradiated surface, b is the fraction which exists as the complex, $K = k_1 IbA$ and $Q' = Q/2{\cdot}303R$.

These equations indicate that the temperature coefficient is independent of the CO_2 concentration and that the rate in flashing light is a direct function of the CO_2 concentration, since b is a function of that concentration.

Emerson and Green's equation for the photostationary state

$$y = k_1 Ix = k_2(a - x)Pe^{-Q/RT}$$

appears to be incorrect. Since $k_2(a - x)Pe^{-Q/RT}$ is the velocity of the dark or Blackman reaction, x will be a maximum after a period of darkness. It follows that $k_1 Ix$ will be a maximum the moment irradiation is commenced and will decrease with time until the photostationary state has been established. The above equation, therefore, cannot express the photostationary state.

It is not possible here to discuss the chemistry of the photosynthetic process, but it may be stated that it is not intended to represent the Blackman reaction as being uni-molecular. It is bi-molecular, but since the concentration of the second reactant is assumed to be large and sensibly constant, it is included in the constant k_2. A complete account will be given in a separate communication.

E. C. C. BALY.

Chemical Laboratories,
University, Liverpool.
Nov. 20.

[1] NATURE, 134, 289, August 25, 1934.
[2] NATURE, 133, 414, March 17, 1934.

Inhibitors of Catalase Reaction

IT is well known that the activity of catalase is greatly inhibited by very small concentrations of potassium cyanide, hydrogen sulphide and especially hydroxylamine. To these reagents we can now add sodium azide (NaN_3) which also acts as a strong inhibitor of catalase.

In a recently published note, Sevag and Maiweg[1] have announced the discovery of a new type of catalase poison belonging to the group of oximes. They have found, however, that these compounds when used freshly prepared have no poisoning properties. The inhibitory property of the oxime solution is manifested only after acidifying it with dilute hydrochloric acid, warming for twenty minutes and neutralising with dilute soda. It is interesting to note that this inhibitory property was found by these authors to be proportional to the strength of acid used in their manipulation.

Following the technique described by Sevag and Maiweg, 0·232 gm. of dimethylglyoxime ($CH_3C(NOH).C(NOH).CH_3$) was dissolved in 100 c.c. of water, containing 10 c.c. normal hydrochloric acid, warmed for 20 minutes on a water bath and neutralised with normal caustic soda.

The solution thus prepared, contrary to the

statement made by these authors, was found to contain a large concentration of hydroxylamine. This solution, like hydroxylamine and unlike oxime, on addition of sodium nitroprusside and a little caustic soda, turns red on heating. Like hydroxylamine it oxidises hæmoglobin to methæmoglobin. It precipitates cuprous oxide from an alkaline solution of copper sulphate, and the titration of this solution with Fehling solution reveals the presence of about 87 mgm. of free hydroxylamine. We find therefore that about 66 per cent oxime was decomposed, liberating a corresponding amount of hydroxylamine.

On testing this solution with nickel it was found to contain only 29 per cent of undecomposed dimethylglyoxime, which conforms fairly well with the previous estimation of the free hydroxylamine.

These results show that 0·018 M solution of oxime treated by the method of Sevag and Maiweg gives approximately 0·024 M solution of hydroxylamine. In other words, the molar concentration of hydroxylamine (a well-known catalase inhibitor) in Sevag and Maiweg's solution, at the end of their manipulation, was higher than the initial concentration of the oxime. It is not surprising, therefore, that their solution had such a powerful inhibitory action on catalase.

D. KEILIN.
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[1] Sevag, M. G., and Maiweg, Lore, *Naturwissenschaften*, 22, 561; 1934.

Passage of Very Fast Protons through Matter

IT is now generally assumed in nuclear theories[1] that the interaction between a neutron and a proton is of the form

$$- J(r)\, S \qquad (1)$$

where $J(r)$ is some function of the distance r between them, and S is the operator which interchanges the space co-ordinates but not the spin of the two particles. Such an interaction has some important consequences in the passage of very fast protons through matter.

We consider a collision in which the neutron is initially at rest, and the proton moving with a large momentum such that the wave-length is small compared to the effective radius of the interaction $J(r)$. Then, as Wick[2] has pointed out, with an exchange interaction of the type (1), most of the *neutrons* are thrown in the forward direction. (With a non-exchange interaction, most of the protons would be scattered in the forward direction.) To calculate the magnitude of the collision cross section we must make some assumption about the form of $J(r)$, of which we know very little. Assuming $J(r)$ to be of the form

$$J(r) = a\, e^{-br} \qquad (2)$$

the effective cross section, calculated by the Born approximation, for the scattering of the neutron in the solid angle $d\omega$ making an angle θ with the original direction of the proton is

$$\frac{256\pi^4}{h^4}\,\frac{a^2b^2}{\left\{b^2+\frac{4\pi^2}{h^2}\left|\underline{p_1}-\underline{p_0}\right|^2\right\}^4}\times$$
$$\frac{p_1^3\,E_0\,E_1}{p_0\left\{p_1+\frac{E_1}{E_0+Mc^2-E_1}(p_1-p_0\cos\theta)\right\}^2 c^4}\,d\omega \qquad (3)$$

where $p_0 = Mv/\sqrt{(1 - v^2/c^2)}$ is the initial momentum of the proton, v its velocity, M the mass of the proton or neutron assumed equal, and $E_0 = c\sqrt{(p_0^2 + M^2c^2)}$ the initial energy of the proton. E_1, p_1 are the energy and momentum of the neutron given by the conservation of energy and momentum for a particle scattered at an angle θ. The effective cross section for the scattering of the neutron in any angle less than θ is

$$q(\theta)=\frac{64\pi^3}{3}\,\frac{E_0^2}{c^2p_0^2}\cdot\frac{a^2b^2}{h^2c^2}\left[\frac{1}{b^6}-\frac{1}{\left\{b^2+\left(\frac{2\pi p_0}{h}\right)^2\sin^2\theta\right\}^3}\right] \qquad (4)$$

where we have neglected terms of the order $(hb/2\pi Mc)^2$. When $2\pi p_0/h \gg b$, (3) has a very strong maximum in the forward direction, and in this case the mean angle $\bar{\theta}$ at which the neutrons are ejected is

$$\bar{\theta} = \frac{1}{\sqrt{2}}\cdot\frac{hb}{2\pi p_0}, \qquad (5)$$

and the neutron has on the average an energy less than the original energy of the proton by an amount δ, where

$$\delta = \frac{1}{16\pi^2}\cdot\frac{h^2b^2}{M}. \qquad (6)$$

Taking $a = 1{\cdot}4 \times 10^{-4}$ erg, $b = 6{\cdot}8 \times 10^{12}$ cm.$^{-1}$, being the values determined by Wick[3] from the stability of oxygen, the total cross section for an encounter q, got by neglecting the last term in square brackets in (4), is $0{\cdot}16 \times 10^{-24}$ cm.^{2}, $\bar{\theta} = 1{\cdot}1^\circ$, and $\delta \approx 0{\cdot}47 \times 10^6$ e.v., for a proton with $E_0 = 5 \times 10^9$ e.v. $\approx 5{\cdot}4\ Mc^2$, such as might possibly occur in cosmic radiation.

Thus, such a proton in its passage through matter will go on until it collides with a neutron and gives nearly all its energy to the neutron. The neutron will travel until it collides with a proton in the material as given by (4), (5), (6), and the proton which is thus ejected will have very nearly the same energy as the original proton, and travel in very nearly the same direction. Further, for protons of such high energies we should expect to be able to treat the neutrons in nuclei as free, so that, using the cross section given above, the mean 'range' of a proton in lead is about 1·5 cm., and that of the neutron about 2·3 cm., as the lead nucleus contains 82 protons and about 125 neutrons. Therefore in going through a metre of lead there will be roughly twenty-five changes from proton to neutron and back, and the total energy loss due to ionisation of the emerging proton will be about half that to be expected theoretically since more than half the distance will be travelled by neutrons.

We may remark, that with the values of a and b assumed above, an accurate calculation[3] of the cross section for the collision of neutrons of energy roughly $3{\cdot}8 \times 10^6$ e.v. with protons gives a result which is nearly four times larger than the cross section found by Chadwick. Our results may therefore be too large by a factor four.

The above expressions are further inaccurate inasmuch as (a) there is no relativistic wave equation for the proton, and (b) the interaction energy (1) can be represented by a potential $J(r)$ probably only in non-relativistic approximation. One might hope that the correct relativistic treatment would reduce the total cross section given above.

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[1] W. Heisenberg, *Z. Phys.*, 80, 587; 1933. E. Majorana, *Z. Phys.*, 82, 137; 1933.
[2] G. C. Wick, *Z. Phys.*, 84, 799; 1933.
[3] G. C. Wick, *Nuovo Cimento*, 11, 235; 1934.

An Equation for the Kinetics of Activated Adsorption

FOR an understanding of the nature of so-called activated adsorption, the kinetic characteristics of these types of processes are of the greatest importance. From the first conception of Taylor one might expect to find kinetic equations, based on the molecular kinetic theory of Langmuir, taking into account the low condensation coefficient increasing with the temperature. But, as I have shown in a lecture on activated adsorption given in Moscow (1932) at the IX Physical-Chemical Conference[1], of all cases of activated adsorption known at this time, not one obeys these equations. The well-known diffusion kinetics equations also cannot be applied to these systems.

Somewhat later, in our laboratory, J. Zeldowitsh showed that for the chemosorption of carbon monoxide on manganese dioxide, the velocity of the process can be well expressed by the following simple equation:

$$\frac{dq}{dt} = V_0 e^{-\alpha q}; \quad V_0 = be^{-E/RT} \qquad (1)$$

where q is the quantity of gas adsorbed during the time t, α and b are constants, characteristic for the given system[2]. On account of the high value of α, the velocity of adsorption diminishes several tenfold before saturation is half reached.

At first we did not assign fundamental significance to this empirical equation, but an analysis of the literature has shown that the kinetics of most of the known cases of activated adsorption, differing widely in their chemical nature and temperature range, follow an analogous law. Thus, for example, this equation written in a more convenient form:

$$q = \frac{1}{\alpha} \ln (t + t_0) + C \qquad (2)$$

where $t_0 = \frac{1}{\alpha . V_0}$ and $C = \frac{1}{\alpha} \ln \alpha \, V_0$

is satisfied by the data of Emett and Brunauer[3] on the sorption of nitrogen in iron, those of Benton and Drake[4] for oxygen on silver, those of Taylor and Sickman[5] for hydrogen on zinc oxide, etc.

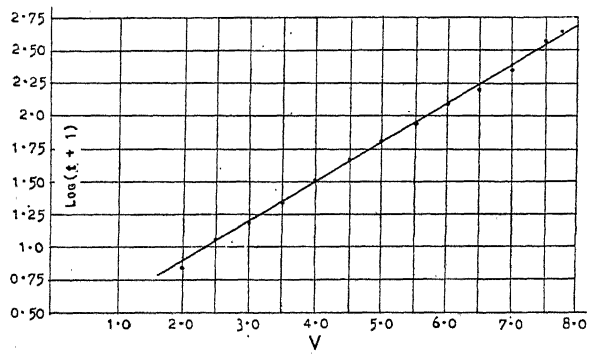

FIG. 1.

It is easy to show that the adsorption of ethylene on nickel in a recent paper of Steacie and Stovel[6] is very well expressed by this equation. The agreement is shown on Fig. 1 which shows the activated sorption as a function of time, for the 142° curve in Fig. 1 of Steacie and Stovel's paper. Thus we may suppose that an equation of type 2) *is a general equation for the kinetics of activated sorption*. It is easy to show that equations (1) and (2) *cannot* be derived from the usual ideas as to the character of activated adsorption, and that they lead to a very peculiar picture of the course of such processes, which at the same time gives an explanation for the appearance of large steric factors (another characteristic of activated adsorption).

We shall return to these equations in a fuller paper to appear soon.

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Oct. 24.

[1] S. Roginsky, *J. Phys. Chem.* (Russ.), **5**, 175; 1934.
[2] S. Roginsky and J. Zeldowitsh, *Acta phisico-chimica*, 1, 1934 (in print).
[3] Emmet and Brunauer, *J. Amer. Chem. Soc.*, **56**, 35; 1934.
[4] Benton and Drake, *ibid.*, **56**, 255; 1934.
[5] Taylor and Sickman, *ibid.*, **54**, 602; 1932.
[6] Steacie and Stovel, *J. Chem. Phys.*, **2**, 581; 1934.

Absorption of Light in Gases

CONTINUING an earlier experiment[1], we have measured the absorption of light by cæsium vapour in the presence of helium. We find that the addition of helium greatly reduces the absorption by cæsium, about 3 cm. of helium being sufficient to reduce it to half the value obtained for cæsium in vacuum. Frank[2] and Mrozowski[3] have shown that the continuous molecular absorption of mercury, zinc and cadmium vapours is proportional to P^{γ}, where P is the vapour pressure and γ is a constant (for one wave-length). For different wave-lengths, γ lies between 1 and 2. Thus the absorption increases less rapidly than the molecular concentration. Their results may perhaps be explained if there is a reduction of absorption, due to collisions between atoms and molecules in the vapour, similar to the effect we have found in cæsium and helium.

Other work[4] has shown that the absorption of light by reacting gas mixtures is not equal to that calculated by summing the absorption of the constituents, the absorption being apparently increased.

Thus it is not possible to assume that in general the absorption of a gas is simply proportional to the concentration of the atom or molecule producing the absorption. It would appear probable that many calculations (particularly in photo-chemistry and stellar physics) may need revision in the light of the above results.

In all experiments where a large pressure effect has been found, the absorption has been due to transitions involving one unquantised state. It is known[5] that the magnitude of the line absorption of atoms (where two quantised states are involved) is not greatly affected by the addition of foreign gases. Further experiments on continuous absorption and molecular band absorption are in progress.

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[1] *Proc. Roy. Soc.*, A, **143**, 472; 1934.
[2] *Phys. Z. Sowjet Union*, **4**, 637; 1933.
[3] *Z. Phys.*, **91**, 600; 1934.
[4] NATURE, **134**, 848, Dec. 1, 1934.
[5] Fuchtbauer, Joos and Dinkelacker, *Ann. Phys.*, **71**, 204; 1923.

Gyromagnetic Effect for a Ferromagnetic Substance above its Curie Point

UP to the present, no satisfactory explanation has been given for the magnitudes of the magnetic moment per atom of ferromagnetic substances as deduced from the saturation intensities at low temperatures. Furthermore, these data do not admit of correlation with the magnetic moment per atom (or ion) obtained from susceptibility measurements of the ferromagnetics above the Curie point. Hence it is advisable to measure the gyromagnetic ratio for a ferromagnetic substance above its Curie point in order to find the origin of the paramagnetism in this region.

Experimental difficulties preclude measurements at temperatures above room temperature, and so it is necessary to choose an alloy the critical point of which is in the neighbourhood of 0° C., or lower. A suitable alloy is found in the nickel-copper series, which possesses the additional advantage that the magnetic moment per nickel atom in the paramagnetic state is independent of the concentration in the range of alloys concerned; that is, it is the same as in pure nickel. The experimental difficulties are considerably greater than those encountered in the case of normal paramagnetic substances which I have investigated, being further complicated by hysteresis and permanent magnetic moment as additional sources of error. However, results were obtained on three different alloys (nickel content $\sim$ 56·5 per cent) the Curie points of which were − 14°, − 9° and − 2° C., the mass susceptibilities ranging from 98 to 180×10^{-6}. The mean result for g is 1·9 with an estimated accuracy of 10 per cent. Thus the g value of 2·0 is within experimental error, indicating that the paramagnetism of the nickel is due to spin alone, as in the case for the ferromagnetic state.

Opportunity was taken to make a systematic test of the contention made by Barnett that my results on the gyromagnetic effect for paramagnetic substances, as well as earlier work on ferromagnetics, are vitiated by unsuspected sources of error peculiar to English physicists[1]. Conditions were particularly favourable to such tests as the disturbing effects are particularly large for the alloys investigated above. In no case, however, was any error detected in the technique previously employed. A full account of the work will appear elsewhere.

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[1] Barnett, *Phys. Z.*, **35**, 203; 1933. For discussion, see also Bates, NATURE, **134**, 50, July 14, 1934.

Humidity-Resistance Relations in Carbon-Coated Hygroscopic Materials

RECENT notes[1] on paper hygrometry recalled to me some earlier observations by myself on the decrease in electrical resistance with drying of a paper coated with a glue-lampblack mixture, and have led to further experiments with carbon-coated hygroscopic materials. This decrease in resistance is attributed to the closer and more numerous carbon contacts as the paper shrinks.

Data for the paper mentioned above, for 'Cellophane' with indian ink lines, and for human hair coated with indian ink appear in Fig. 1. For the paper and the 'Cellophane', the resistances are the equilibrium values attained in fanned air after standing over either calcium chloride or a saturated solution of potassium chloride (86 per cent relative humidity). The hair was studied only in quiet atmospheres of various humidities provided by salt solutions. The temperatures were those of the room.

Both the paper and the 'Cellophane' were 'conditioned'. They were exposed, alternately, to dry and to moist atmospheres until their resistances approached nearly constant lower values at given humidities. Half a dozen wet-dry cycles were sufficient. The hair was not so conditioned. All data obtained with it appear in Fig. 1.

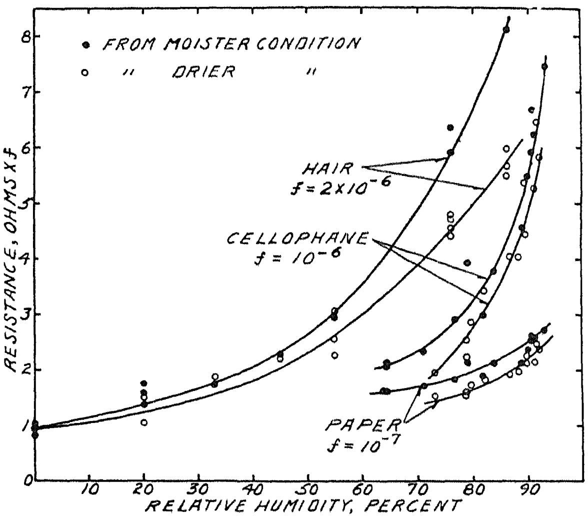

FIG. 1.

In nearly saturated atmospheres, the electrolytic conduction in the paper predominated over the conduction by carbon. As a consequence, its resistance passed through a maximum when the atmosphere changed to or from saturation. Corresponding experiments with 'Cellophane' and hair were not made.

The paper and 'Cellophane' resistors were 20 cm. × 1·25 cm., with ends dipping 1 cm. into mercury wells. The hair resistor consisted of 27 segments in parallel, each 2·5 cm. long. The hair had been boiled in ethyl ether. Resistances were computed from the currents given by a 1·5 volt dry cell.

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[1] K. Mellanby, NATURE, **132**, 66, July 8, 1933. J. Grant, *ibid.*, 677, Oct. 28, 1933. P. H. Prior, *ibid.*, 857, Dec. 2, 1933.

The Maüle Reaction and the Systematic Position of the Gnetales

IN a book just issued[1], Dr. Hagerup, of Copenhagen, has revived the much-debated question of the origin of the Angiosperms, basing his conclusions on a detailed, comparative study of the organogeny of the floral structures in a series of representative species of the Gnetales, Piperaceæ and Juglandaceæ. From this investigation he derives support for the belief in the close relationship of the Piperaceæ and the Gnetales, the differences between them being, in his view, of minor importance morphologically; so that either the Gnetales should be added to the Angiosperms, as Lignier contended, or the Piperaceæ should be regarded as having arisen directly from

gymnospermic ancestors through the Gnetales, as the author himself maintains.

These conclusions have been based upon observations, admirably extensive, but along organographical lines only, and they have been opposed, in review, on that ground. It is therefore worth while directing attention to supporting evidence from an entirely different side.

The long-neglected Maüle reaction[2] consists in the chlorination of lignin by treatment with potassium permanganate and strong hydrochloric acid (the original procedure) or directly with chlorine water, followed by ammonia, which may be replaced by an alkali or an organic base. The result is a bright red colour of unknown chemical nature which appears to be an indicator, colourless in the acid form and with red salts, with a C = O chromophore group in the molecule.

This reaction was claimed by Maüle as specific for Angiosperm wood, and an extensive test by us in 1932–33, covering forty-three families of Angiosperms, supports this claim, with the outstanding exception that the colour is also given by the wood of all three genera of Gnetales and by them alone among non-Angiosperms, except in the sclerenchyma (not the xylem) of two species of *Stangeria* and possibly also one species of *Podocarpus*, which gives a weak reaction according to Crocker[3].

The Gnetales stand out conspicuously in sharing this distinctively angiospermic element of constitution.

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[1] Hagerup, "Zur Abstammung einiger Angiospermen durch Gnetales und Coniferae". Copenhagen, 1934.
[2] Maüle, *Bei. Wiss. Bot.*, **4**, 166; 1901.
[3] Crocker, *Bot. Gaz.*, 95, 168; 1933.

Traffic Noise

Now that so much is being done in order to find means of reducing street and other noises, it may be worth while considering whether there are not more factors than intensity and character of the noise to be taken into account. It is fairly probable that any noise is more objectionable when it is intermittent; and it is also possible that an intermittent noise with quick rate of change is more objectionable than one in which the rate is slow.

Sir Herbert Maxwell points out in NATURE of November 3 that horse traffic used to be more noisy than the present-day motors; but it certainly caused less annoyance. May not the reason, or one of the reasons, be that changing gear or using a cut-out involves sudden change in noise; and may not the greater speed of modern traffic be a contributing cause of the trouble, in that fast approach of a noisy vehicle results in greater rate of change of noise as heard by anyone at a standstill? The clatter of a two-horse dray rumbling over granite setts was continuous, and became audible gradually to anyone who was not on the move; but the noises created by a motor cycle without silencer, or by a bus changing gear after getting under way involve quick rate of change. I am sure that rate of change must be taken into account in deciding whether a given noise is objectionable or not.

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Corrections to the Refractive Indices of Quartz in the Infra-Red

IN the region 3–4 μ, the dispersive power of crystalline quartz (ordinary ray) is about four times that of fluorite and thirteen to fourteen times that of rock-salt, but, because of strong absorption beyond 3·6 μ and also between 2·8 μ and 3·1 μ, quartz has been neglected as a prism material in this part of the spectrum. The high dispersive power does, nevertheless, more than compensate for the loss due to absorption, and better resolution is obtainable than with fluorite.

When prisms of quartz and fluorite were used in a recent research, it was found that wave-length discrepancies occurred between the results obtained with the two prisms, and these were traceable to the relatively inaccurate data for the refractive indices of quartz. The figures available for quartz in this region are due to Rubens[1], who measured the refractive indices of both quartz and fluorite by the method of coincidences, using a wire grating; later he corrected his results to be in accordance with Paschen's more accurate values for fluorite[2]. Paschen[3] has since given still more accurate data for fluorite, and Rubens' values for quartz are no longer correlated with these. Moreover, the dispersion curve for quartz up to 3 μ is accurately known[4] and is smooth, while Rubens' curve, in addition to showing two rather abrupt bends, does not join up well with this but intersects it at a small angle at 3 μ.

From the comparison of the results lately obtained with quartz and fluorite prisms, values for the refractive indices of quartz have been estimated for several wave-lengths between 3 μ and 3·8 μ, and these, when plotted, are found to lie on a smooth continuation of the curve up to 3 μ. These corrected refractive indices of quartz are given in the accompanying table, and should be regarded as provisional values, suitable for adoption until direct determinations of greater accuracy become available, whilst not in any way obviating the need for the latter. The corrections proposed, it will be seen, are of quite appreciable magnitude.

λ	n (Rubens)	n (Corrected)	Difference
3·03 μ	1·4987	1·4987	0
3·18	1·4944	1·4947	+0·0003
3·40	1·4879	1·4885	+0·0006
3·63	1·4799	1·4809	+0·0010
3·80	1·4740	1·4746	+0·0006
3·87	(1·4715)*	1·4715	0

* Interpolated value.

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[1] Rubens, *Ann. Phys.*, **53**, 273; 1894.
[2] Paschen, *Ann. Phys.*, **53**, 325; 1894.
[3] Paschen, *Ann. Phys.*, **4**, 299; 1901. **41**, 670; 1913.
[4] Paschen, *Ann. Phys.*, **35**, 1005; 1911. Carvallo, *C.R.*, **126**, 728; 1898. Coblentz, *Sci. Pap. Bur. Stan.*, **16**, 701; 1920.

Spectrum of Acrolein

IN connexion with measurements on the photochemical decomposition of acrolein we have measured (Hilger E 315 spectrograph) its ultra-violet absorption spectrum. There are two distinct regions of absorption, one consisting of bands with no overlapping continuum, extending from *c.* 4000 A. to 2800 A.; the other of continuous absorption beginning at

c. 2300 A. and extending towards higher frequencies. The first region becomes continuous at pressures above c. 60 mm. These results agree essentially with the earlier work of Lüthy[1]. The first region corresponds to absorption by the carbonyl group. Saturated ketones have also been found to give banded absorption below c. 2100 A., so that the second region found here might also involve absorption by the carbonyl group. On the other hand, some facts suggest that the continuous absorption is really to be attributed to a primary excitation of the C = C link. In consequence of the conjugated grouping this may be displaced towards the red as compared with that usually found.

The main feature of the first absorption region is a series of relatively intense pairs of narrow bands. The intervals between the intense pairs are each c. 1260 cm.$^{-1}$, and this is also true of the weaker pairs. This frequency is probably to be associated with a vibration of the molecule

$$\begin{matrix}R\\H\end{matrix}\!\!>\!C\rightarrow\ \leftarrow O$$

agreeing with the values found for other aldehydes. At lower pressures the bands at the long-wave end are fairly sharp but become less sharp at wave-lengths shorter than c. 3500 A.; the point at which the diffuseness begins to be noticed varies with the pressure. At the long-wave end some of the bands show under higher dispersion (Hilger E 1 spectrograph) a distinct fine structure, the nature and magnitude of which is such that it may imply a rotation of the hydrogen atoms and the oxygen atom around an axis close to that of the C–C–C chain. These bands appear to have been analysed by Snow and Eastwood under still higher dispersion[2].

The illumination of acrolein vapour at room temperatures with light of frequencies corresponding to the first region of absorption leads predominantly to a polymerisation, which may imply a long life of the excited state and a much delayed dissociation. The experiments are being extended to propiolic aldehyde, the spectrum of which may show certain simplifications.

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[1] Z. phys. Chem., 107, 285; 1923.
[2] NATURE, 133, 908, June 16, 1934.

Points from Foregoing Letters

THE widespread infestation of potato leaves, especially of the Kerr's Pink variety, with early blight, is indicated by Dr. R. N. Salaman and Miss O'Connor, who describe its occurrence and dangers and indicate methods of checking its ravages.

The chemical combination of the carbon dioxide obtained from the air, with water, in order to form finally sugar, starch and other carbohydrates, occurs in green plants in several stages. Prof. E. C. C. Baly invokes three steps: (1) reaction of chlorophyll with carbon dioxide; (2) further reaction in presence of light to form carbohydrate; (3) Blackman reaction in darkness when chlorophyll goes back to original state.

Sevag and Maiweg's claim to have found a new substance, belonging to the oxime-group, which poisons the enzyme catalase (which increases the rate of liberation of oxygen from peroxides) is disputed by Prof. Keilin and Mr. E. F. Hartree, who find that the oxime solution of Sevag and Maiweg contains hydroxylamine, an already known poison for catalase.

Certain gases are adsorbed by given metals or metallic oxides and are thereby rendered more active in specific chemical reactions (activated adsorption). Prof. S. Roginsky discusses the rate at which such adsorption takes place and maintains that it does not agree with Taylor's theory of the phenomenon.

Prof. Dhar and others have shown that reacting gases absorb more light than the same gases separately. Prof. R. W. Ditchburn and Dr. H. J. J. Braddick find that the simple admixture of two non-reacting gases affects their light-absorbing power. Certain photochemical and astrophysical calculations may need revision in view of these results.

Dr. W. Sucksmith has measured the angle through which certain nickel alloys turn when submitted to varying magnetic fields (gyromagnetic effect). Nickel-copper alloys were chosen, the magnetic susceptibility of which at temperatures above − 14°, − 9° and − 2° C. varies inversely as the absolute temperature (that is, they are paramagnetic). Below these temperatures (Curie points) their susceptibility varies irregularly (that is, they become ferromagnetic). From his measurements Dr. Sucksmith infers that the paramagnetic behaviour of nickel alloys, like the behaviour of ferromagnetic substances in general, is due solely to the spin of the electrons and not to their orbital motion.

The increase in electrical conductivity shown upon drying, which he has measured in certain carbon-coated organic materials, is explained by Dr. Lars A. Welo as being due to the closer contact of the carbon particles when the materials shrink.

The bright-red colour which the wood of flowering plants gives upon chlorination (Maüle reaction) can be used as additional evidence that the family of Gnetales (of which the species *Ephedra*, growing on the sand-dunes of the Mediterranean, is the chief European representative), really belongs to the flowering plants, in spite of their cone-like flowers that have led botanists to include them among the non-flowering cone-bearing plants (Gymnosperms). Prof. R. C. McLean and Miss Myfanwy Evans find, in fact, that all three known genera of Gnetales give the Maüle reaction.

Dr. H. W. Thompson and Mr. J. W. Linnett have measured the light absorption of acrolein in the visible and ultra-violet and discuss the relation of the two absorption bands observed to the molecular structure of that compound. They find that illumination of acrolein vapour with light corresponding to one of the absorption bands leads to molecular aggregation (polymerisation).

Research Items

Iron Age Site, Kilpauk, Madras. A preliminary report on the excavation of what promises to be an important site in the prehistory of southern India has been published by Messrs. M. D. Raghavan and T. G. Aravamuthan (*Current Sci.*, 3, No. 3). The prehistoric cemetery of Kilpauk, Madras, situated in the garden of a bungalow belonging to Mr. E. R. Prudhomme, has been known for about twelve years, and a number of specimens of pottery and a small sarcophagus had been found in the course of laying out the garden. No attempt had been made to explore the site systematically until August last, when operations were begun on behalf of the Madras Government Museum. Up to the date of writing, the authors had extracted a quantity of black-tipped ware, in which the rim and inside are black and the rest red, all-black ware, a figurine of black pottery of high finish, apparently representing a bird, and half of a fine pottery head. Two iron objects were found, of which one was a small hoe blade of a very primitive type with a slightly curved cutting edge and a narrow butt, and the other a stick of iron, about six inches long. The most important find, however, was a sarcophagus about six feet in length, standing on six pairs of short legs, closely resembling specimens found at Pallavaram and Perumbair. It was filled with sand and bits of pottery. A fragment of a human tibia was found nearby. The sarcophagus had been badly damaged by a mango tree root and could not be removed whole. The site has certain distinctive features which mark it off from other prehistoric sites, such as the occurrence of both urn burials and sarcophagus burials, and the abundance of fine pottery. The all-black vessels distinguish Kilpauk from both Perumbair and Adichanallur. Beyond an attribution to the iron age of Southern India, it is as yet too early to attempt any precision in chronological classification.

Pawnee Ritual Games. The Pawnee ghost dance hand game has been made the subject of a study in cultural change by Dr. Alexander Lesser, based in part on field-work among the Pawnee Indians under a project supported by the Columbia Council for Research in the Social Sciences (Columbia Univ. Cont. to Anthropology, No. 16). The Pawnee first came under the United States Government with the purchase of the Louisiana territory in 1803. Their native economy of buffalo hunting accompanied by a digging-stick cultivation of corn and squash broke down with the coming of white settlement, and in 1874–76 they were moved from Nebraska to reservation land in Oklahoma. By 1892, when the Ghost Dance appeared among them, their culture had completely broken down, owing to a great extent to the efforts of the Government to substitute individual agricultural holdings for their village system. Their ceremonies had become functionless and extinct, while their arts, which had centred on the buffalo, had disappeared. They had nothing to look forward to and nothing to live by. The Ghost Dance gave them a new aspiration. In the form of the ritual among the Pawnee the hand game, a gambling game, which under the traditional culture had been associated with hunting and warfare, played an important part. Though there were no longer material stakes, there was still a feeling about winning and losing. In place of the opposing sides being based upon tribal divisions, they were constituted by such distinctions as 'visionaries' against 'innocents', men and women and the like. The incorporation of the hand game in the ghost dance ceremonial seems to have reached the Pawnee from the Arapaho. Only four other tribes appear to have developed the game in this manner. Not only did these games satisfy the desire for creative effort, but the ceremonies were the occasion of social gatherings on a large scale, which lasted over four days, meeting a real need when the tribe had been scattered over allotments.

Bionomics of the Tsetse Fly on the Gold Coast. The species of tsetse fly, *Glossina longipalpis*, Wied., is of great importance as a vector of human and animal trypanosomiasis in West Africa. Of the common tsetse flies, *G. longipalpis* appears to have been the least investigated. The bionomics of this insect in the country around the Gold Coast port of Takoradi forms the subject of a recent paper by Mr. K. R. S. Morris (*Bull. Ent. Res.*, 25, part 3, Sept. 1934). It appears that the main food hosts of this species were bushbuck and duiker. When these small game animals were driven out of a specific fly-belt by farming and wood-cutting, the insect quickly and completely disappeared. Its distribution is dependent more upon humidity than upon temperature. The main vegetational types frequented by the insect are transition forest, inland savannah forest and coastal savannah, where the range of humidities is between 50 and 80 per cent (relative humidity) and the temperature between 75° and 85° F. It does not occur in the rain forest, where the relative humidity is above 80 per cent, or in the northern savannah, where it is as low as 30 per cent in the dry season. By statistical methods, coefficients of correlation were determined for the fly's density-activity and various climatic factors of the fly-belt. The main policy for control should lie in improving and directing the native's methods of bush cultivation. Farms should be as close to villages as possible, contiguous and kept under permanent cultivation. Clearings should be made at least 100 yards wide around bush villages and at least 200 yards wide around important towns. Small clearings and isolated farms are regarded as a danger.

Habits of *Aequideus latifrons*. The Cichlid fishes are always favourites in aquaria and have peculiar breeding habits, either attaching their eggs to some solid support and guarding them, or carrying them in the mouth until hatched. Mr. C. M. Breder, Jr., of the New York Aquarium, in "An Experimental Study of the Reproductive Habits and Life History of the Cichlid Fish *Aequideus latifrons* (Steindachner)" (*Zoologica. Sci. Contrib. New York Zoo. Soc.*, 18, No. 1, 1934) studies a species which deposits its eggs on a substratum. The fishes were the aquarium-bred offspring of specimens collected in 1931 by Mr. A. Eisinger at Barranquilla, Columbia, and were brought to the New York Aquarium when still very small. Their behaviour appeared quite normal and like those studied under field conditions. Eggs may be laid every twenty-five days at a temperature of about 25° C., and hatch in two or three days. They are fanned by the parents' fins during the whole of the

incubation period, and the young are protected until another lot of eggs is ready to be laid. The parental care is strikingly shown in the way that both eggs and young are guarded in the aquarium, for they have many enemies and are eagerly eaten by the non-breeding adults present. If the fishes are disturbed they may remove the eggs altogether, taking them carefully one by one to some sandy hollow and incubating them there. The experiments devised in this research are ingenious, and the sketches and photographs which accompany the paper are very interesting.

Resistance of Mice to Irradiation. Jerome Davis (*Amer. Nat.*, **68**, Sept.-Oct. 1934) discusses the results which he has obtained on the effect of ultra-violet light on mice. Six generations of hairless mice were subjected to ultra-violet light, and a control group was maintained which did not receive this treatment. Three animals from two litters of the sixth irradiated generation, and two controls of the same age were irradiated together. Slight peeling began on the controls after one exposure, but in the experimental animals not until after the fourth exposure. At the end of fifteen exposures, the controls were severely burned, whereas the experimental animals were only slightly so. In the experimental group the burns disappeared within six days, leaving the animals quite normal. The controls, on the other hand, developed hard callouses due to hyperplasia of the epithelium. Davis tentatively suggests that the difference in response to irradiation between the irradiated and control mice may be due to the inheritance of acquired resistance to irradiation. The author, acknowledging that the results are inconclusive, suggests that they may incite others to repeat and extend his work. But it is to be hoped that he will stage a Mendelian experiment with his own stock. It should be a simple matter to show that the tolerance is, or is not, indeed inherited.

Evolution in the Agarics. A long paper by Mr. E. J. H. Corner of Singapore, "An Evolutionary Study in Agarics; *Collybia apalosarca* and the Veils", has appeared (*Trans. Brit. Mycol. Soc.*, **19**, 39–88, Oct. 1934). The account traces the formation and anatomy of the fruit body of *C. apalosarca*, a toadstool-like fungus found growing on wood in Malaya. Characters of the species are given in detail, whilst a new form, *radicans*, and a new variety, *perstipitata*, are also described. The structure of the mature fruit body has been investigated microscopically, and times of spore shedding are correlated with size of the fructification. *C. apalosarca* forms an evolutionary link between *C. radicata* and *Armillaria mucida*, and several interesting comparisons are drawn. For example, the 'root' of *C. radicata* is represented by the lower half of the stem in *C. apalosarca* and by the stem and persistent ring of *A. mucida*. *C. radicata* is supposed to have developed from a naked ancestor; *C. apalosarca* and *A. mucida* from a similar veiled ancestor, whilst the newly-described form and variety mentioned above are intermediates which uphold the hypothesis.

Oxidising Agents as Fertilisers. Iyer, Rajagopalna and Subrahmanyan (*Proc. Indian Acad. Sci.*, **1**, No. 2, p. 106) describe interesting effects of various oxidising agents on crop yield and certain chemical and biological transformations in the soil. Some remarkable increases in yield are recorded, up to 100 per cent, for example, with tomato plants on soil treated with manganese dioxide. Certain other crops responded better to potassium permanganate. Ammonification, with organic manures, was slightly favoured by oxidising agents, and increased oxidation of organic matter was demonstrated by the increased production of carbon dioxide corresponding to the loss of carbon. The treatment also resulted in a temporary increase in the numbers of bacteria and Actinomyces, whilst in some cases depression of fungi occurred. It appears that the results are due more to the facility with which the added substances part with their oxygen than to the effect of the metallic ion, hydrogen peroxide producing effects similar to those of manganese dioxide. Increased formation of bacterial food and consequent increased activity may be involved as well as direct oxidation of organic matter to simpler substances and carbon dioxide.

Deformations of the Crust around Sakura-jima (Japan). Until 1914, Sakura-jima was a volcanic island at the northern end of Kagoshima Bay. After the great eruption on January 12 of that year, it was joined by a stream of lava to the mainland. Series of precise levellings were carried round the head of the bay in 1891–98, 1914, 1915, 1919 and 1932. Prof. C. Tsuboi (*Earthq. Res. Inst. Bull.*, **7**, 103–114; 1929) examined the changes during the first two intervals. The graphs are similar in form; each consists of segments of straight lines, and the ends of segments lie on the same abscissæ, which, according to Tsuboi, correspond with the boundaries of six crust-blocks round the head of the bay. In three of these blocks, the amounts of tilting were 9″, 10″ and 12″, and the directions converge towards a point a short distance to the north of the crater. Prof. N. Miyabe has continued the work for the last two intervals (*Bull.*, **12**, 471–481; 1934). In both, the vertical displacement was reversed in direction, the recovery being at first somewhat rapid. In one crust-block (west of the volcano), the tilting occurred in the same direction as before. In the other two (to the east), the direction of tilting was almost exactly reversed, though less in amount.

Meteorology of the West Indies. The "Handbuch der Klimatologie" of W. Köppen and R. Geiger when complete will be in five volumes (Berlin: Gebrüder Borntraeger, 1934). A number of different parts of this work have already appeared as each has been completed, of which the most recent (Band 2, Teil 1) is entitled "Climatology of the West Indies". The text of this was written in 1927 by the late Prof. R. de C. Ward, formerly professor of climatology at Harvard University, who compiled his account largely on the basis of summaries by W. W. Reed that had appeared a year earlier in the *Monthly Weather Review*. Prof. C. F. Brooks, director of Blue Hill Observatory, with the help of Miss E. M. Fitton and others, extended the tables and summaries; finally Prof. Ward revised the whole work shortly before his death. European meteorologists hear of these regions chiefly in connexion with tropical hurricanes, but the introductory part of this work shows that there are other aspects of their meteorology of almost equal interest. The West Indies show great uniformity of temperature, such as is to be expected of islands of which the greater number lie just within the tropics, but those nearest to the mainland of Central America feel to some extent the effect of the winter cold waves of North America, resulting from south-

ward incursions of polar air; the more easterly and southerly members of the group escape these effects and have a correspondingly small annual range (2° C. only at Barbados). While temperature changes are unexciting and the simple régime of the north-east trade winds is only rarely disturbed by a hurricane, rainfall shows great variability both in the amount experienced in different years at one place and in the normal amount received at places no great distance apart. At Silver Hill, Jamaica, the total fall in three days, November 5–7, 1909, was 2,159 mm. (85 in.) and in the seven days to November 11, it was 3,428 mm. (135 in.). In the same island, two places only 30 miles apart and differing in elevation by only 189 metres have normal annual totals of 735 and 5,638 mm. respectively. The numerous detailed tables in this work repay study, for example, Table 12, which shows thunderstorm frequency. Some of the islands have only about the same number as the English Midlands, but at Port au Prince (Haiti) the annual frequency is about 107.

The Energies of the Positrons in Induced Radioactivity. Y. Nishira, R. Sagane, M. Takeuchi and R. Tomita (*Sci. Pap. Inst. Phys. Chem. Res., Tokyo*, Sept. 1934) have investigated the energy distribution spectrum of the positrons emitted for radio phosphorus ($_{15}P^{30}$) obtained by activating aluminium by bombardment with α-particles. The activated metal was brought up to a Wilson cloud chamber arranged in a solenoid. The positrons passed through a thin aluminium window into the chamber. The energy distribution is apparently continuous, with a maximum intensity about $0 \cdot 8 \times 10^6$ e.v., and the upper limit of energy is probably in the neighbourhood of 4×10^6 e.v. The results are compared with those obtained by Curie-Joliot, Meitner, Alichanow and others, and by Ellis and Henderson, and published in recent papers. Most of these authors find a rather lower value for the energy at the upper limit. It is suspected that there are other peaks in the energy distribution, but these may well be due simply to statistical fluctuations.

Fast Mercury Ions and the Excitation of X-Rays. D. H. Sloan and W. M. Coates have recently described the further development of the Laurence-Sloan apparatus for accelerating heavy ions in stages to energies of the order 3 million volts (*Phys. Rev.*, Oct. 1). The ions travel through a series of copper tubes which are connected alternately to opposite poles of a high-frequency circuit, and the length of the accelerators is so arranged that an ion once accelerated into the first cylinder passes from one to another always at the right time to receive an acceleration. Detail improvements in the accelerators and their connexions enable higher voltages to be employed than formerly. The maximum voltage applied is 79,000 volts at about 10 megacycles, and about 10 kw. is supplied to the oscillator. About 10^{-8} amp. of mercury ions were obtained at $2 \cdot 8 \times 10^6$ volts. A second paper by W. M. Coates describes the production of X-rays by mercury ions having energies up to $2 \cdot 4$ million electron volts. The X-rays were definitely produced by the ions since they were unaffected by the use of electric and magnetic fields sufficient to eliminate cathode rays from the beam striking the target, while they were stopped by a foil which stopped the positive ions but would be transparent to X-rays produced in other parts of the tube. No radiation was observed from targets of lithium, boron, oxygen, sodium, nickel or copper. X-rays were detected and the absorption coefficients measured in aluminium and air, for the target elements aluminium, sulphur (probably K-radiation), bromine (probably L-radiation), molybdenum, silver, tin and lead (radiation not identified with certainty). The radiation was in all cases too weak to measure below 300 kv., and increased rapidly with increasing energy of the ions. It is suggested that these rays are produced by the bombarding ion and the target atom approaching sufficiently close to form a quasi-molecule with the two M shells (say) overlapping. When the 'molecule' breaks up, one of the atoms loses one of its inner electrons and the subsequent rearrangement gives rise to characteristic radiation. The observed threshold value for the energy of the exciting ion gives a distance of approach of the two nuclei which agrees roughly with this hypothesis.

Tidal Friction and Planetary Motion. Much time and labour were devoted by the late Sir G. H. Darwin to a step-by-step investigation of the cumulative effects of tidal friction upon the motion of the earth and moon. Lord Kelvin suggested that a more general and less laborious treatment could be obtained by considering the energy and angular momentum. In recent times the problem has been taken up again, by the aid of general theorems in Hamiltonian dynamics. T. Levi-Civita, who has himself worked on the subject, gives (*Amer. Math. Mon.*, **41**, 1934) an account of the methods used by G. Krall, which are remarkable in that they enable one to describe the behaviour of a planetary system after an indefinitely great time without calculating the intermediate stages. The conclusions are that everything tends towards a state of uniformity, in which all the bodies will describe circular orbits about their common centre of mass with equal angular velocities. Moreover, each axis of rotation will be perpendicular to the orbital plane, and the period about this axis will be the same for all. In other words, on each planet the length of the year will be the same, and also the length of the day, and there will be no distinction between summer and winter. The above results are for systems which have kinetic energy of rotation comparable with that of translation. A case which has not yet been worked out is that in which the resultant angular momentum is zero. The ultimate fate of such a planetary system would be a catastrophe in which all the bodies collided.

Sunspot Numbers. Tables of monthly and annual sunspot numbers from 1749 to 1933, as determined at Zurich, are given in the September issue of *Terrestrial Magnetism and Atmospheric Electricity*, and are accompanied by a similar table, for the years 1917–33, of the sunspot numbers derived from the central zone of the sun, and a table of monthly intensity of ultra-violet solar radiation at Mount Wilson for the period 1924–33. Diagrams for 1923–33 of the central-zone *daily* sunspot numbers, and of the international daily magnetic character figures, arranged in 27-day sequences, are given by J. Bartels, and illustrate again the fact that strong and long-lived active regions occur on the sun, which affect the earth's magnetic state, even throughout periods in which the sun is practically spotless. The same issue contains two articles, by H. W. Wells and L. V. Berkner, on measurements of the E and F ionised layers of the atmosphere above Huancayo, in Peru, at latitude 12° S.

The British Institute of Radiology

Annual Congress and Exhibition

THE eighth Annual Congress of the British Institute of Radiology, and an exhibition of radiological apparatus organised by the X-ray industry were held at the Central Hall, Westminster, on December 5–7. The morning of December 6 was devoted to the reading of physical and technical papers, contributions being made by Prof. F. L. Hopwood, Dr. A. Müller, Dr. R. E. Clay and Mr. A. G. Warren.

Prof. Hopwood, giving a demonstration of induced radioactivity, traced briefly the history of the subject starting with the work of M. and Mme. Joliot (1933), who by bombardment with α-particles, induced radioactivity in various substances of atomic number less than that of potassium. He referred to the work of Cockroft and Walton, who produced similar effects with high-speed α-particles, and also to the various results obtained with neutrons, stating that Fermi has excited fifty elements. Prof. Hopwood and his colleagues at St. Bartholomew's Hospital have found that induced radioactivity can be brought about by neutrons emitted from beryllium irradiated by γ-rays. Following on this work, they endeavoured to induce radioactivity by means of high-voltage X-rays. No effect could be detected as a result of irradiation by X-rays excited at 200 kv. or at 400 kv., but the desired effect was produced by X-rays produced at much higher voltages. Bromoform was used for the purpose, and after irradiation in Germany, the sample was brought to London by air and the radioactive bromine separated by chemical means (see NATURE, Dec. 8, p. 880). Bromine apparently gives rise to two radioactive forms, one having a half-value time of about 6 hours, and the other having a half-value time of 30 minutes. It was stated that radioactivity has now been induced in all the elements found in the human body except calcium and hydrogen.

For the purpose of demonstration, Prof. Hopwood showed, by means of a Geiger counter, the induced radioactivity in aluminium (slightly active) and in silver (strongly active). The latter case was of particular interest, as the half-value period of the silver is about 3 minutes, and the decay could readily be detected. Induced radioactivity in a piece of ivory was also demonstrated.

Dr. A. Müller and Dr. R. E. Clay gave a paper on the "X-ray Plant at the Davy-Faraday Laboratory". The simplest apparatus, a small induction coil with a Wehnelt interrupter operating an X-ray tube of the gas type, was demonstrated, and typical crystal photographs were made and developed in the course of the lecture. The authors then pointed out that the principal difficulty in designing high-powered X-ray equipment lies in dissipating the heat generated at the target, and showed mathematically that the maximum permissible loading of a tube depends on the square root of the area of the focus. If the focus is to be kept small and the power increased, recourse is had to a tube employing a rotating anode, and a tube, capable of withstanding a continuous loading of 16 kw. (450 ma. at 35 kv.), has been made and found satisfactory. This tube embodies a target about 20 in. in diameter, rotating at a speed of 2,000 rev. per minute. Using a high-powered X-ray tube of this type, it is possible to work with crystal-film distances of 3 metres, and so obtain a very high resolving power.

The authors are considering the design of a tube capable of handling 50 kw. but are of the opinion that it would not be possible to go to much higher powers, since the maximum permissible loading of a tube having a rotating anode varies only as the square root of the peripheral velocity. Tubes of power much greater than 50 kw. would therefore have to be very large and to rotate at high speeds, and the mechanical stresses would approach the ultimate strength of steel.

Mr. A. G. Warren, in a paper on "The Detection of Small Flaws in Metals by Radiography", discussed in considerable detail the detection of cracks and 'flakes' particularly in steel. He showed that the possibility of detecting cracks radiographically depends partly on their dimensions and partly on their obliquity to the X-rays, and that over a wide range of dimensions a criterion could be found from consideration of the area of cross-section of the flaws. The minimum cross-section of a detectable flaw can be found by ascertaining the cross-sectional area of the finest wire, laid above the specimen, which could be detected on the radiograph. As an example of the minimum size detectable, Mr. Warren showed that, in steel 1 in. thick, a crack of width 0·004 in. and a depth exceeding 0·02 in. can be detected with certainty.

The fifteenth Mackenzie Davidson Memorial Lecture was given on December 7 by Sir William Bragg, on "X-rays and the Coarse Structure of Materials". After explaining briefly the rudiments of the subject, he described recent work carried out on organic ring compounds, and showed that by X-ray means it is possible to make a kind of 'contour map' giving the distribution of electron density in the crystals, which reveals a structure agreeing closely with that arrived at from considerations of the chemistry of the substances. The energetics of substances can be studied by chemical means and also by consideration of the electrical forces holding the atoms together, and the two methods give similar results, but indicate tensile strengths much higher than those usually observed. The discrepancy is attributed to surface defects, which have the effect of weakening the structure, and recent experiments have shown that if the experimental conditions are arranged so that the weaker parts of the sample are not stressed, values for tensile strengths agreeing with those calculated are obtained.

Higher values for tensile strengths are obtained in a vacuum than in air—a result attributed to the effect of water vapour absorbed in interstices, which has the effect of reducing the electrical forces. A piece of mica cleaved in a vacuum will recover when the surfaces are put into contact again, although in air the cleavage is permanent. This effect may be explained on the assumption that water vapour absorbed from the air disturbs the electrical field and prevents cohesion taking place, while in a vacuum the electric field is stable and cohesion readily occurs.

A new apparatus of interest to physicists shown at the exhibition was a high-voltage rectifier of the copper oxide type capable of withstanding an inverse voltage of 200 kv. and passing a current of 30 ma. The complete rectifier is built of smaller units arranged in series, mounted in oil in a metal case and provided with suitable insulators for operation at high potentials to earth.

Centenary of the University of Brussels

THE Université Libre de Bruxelles was founded on November 20, 1834, by Theodore Verhaegen (1796–1892) and a group of friends, a few days after the opening on November 4 of the Catholic University at Louvain. It was housed at first in the buildings now occupied by the Musée Moderne, but was removed in 1842 to the site in the rue des Sols which it occupied until recently. After the War, mainly through the generosity of the "Commission for Relief in Belgium" and the Rockefeller Foundation, a new Cité Universitaire was created at Solbosch, adjoining the Bois de la Cambre. These buildings include a very fine hall and library with appropriate buildings for the faculties of arts and law, whilst the faculties of science are housed in a capacious but more utilitarian building behind the main frontage. A large hostel has also been provided for men and women students, with generous accommodation for non-residents.

The centenary celebrations extended over three days, November 18–20. On the evening of November 18, a reception was given by the Collège des bourgmestres et échevins at the Hotel de Ville, where the guests were received by Bourgmestre Max. The principal function took place in the hall of the University in the presence of H.M. the King of the Belgians. This session was presided over by Bourgmestre Max, and addressed by M. Paul Hymans (Foreign Minister), M. Maistriau (the retiring Minister of Public Instruction), and representatives of past and present students. The Rector, M. Bogaert, announced the names of some twenty-five new doctors *honoris causa*, of whom the first was the King himself. In addition to those associated with the faculties of philosophy and of law, the faculty of medicine had nominated Sir Henry Dale, director of the National Institute for Medical Research in Great Britain, Prof. van den Bergh of the University of Utrecht, and Sir Frederick Gowland Hopkins, president of the Royal Society. The faculty of pure science had nominated Profs. Cayeux, Cotton and Hadamard, members of the Institut de France, Prof. Krismer, emeritus Professor of the École Militaire at Brussels, and Prof. T. M. Lowry of the University of Cambridge. The faculty of applied science had nominated M. Pelseneer, permanent secretary of the Académie Royale de Belgique, Prof. Swarts of the University of Ghent, Prof. Debye of the University of Leipzig (at present visiting professor at Liège on the Francqui Foundation) and Prof. Janet, honorary professor of the University of Paris. At the conclusion of the ceremony, the past and present honorary doctors were received by the King in person.

Public lectures on legal and philosophical subjects were given in the afternoon, and in the evening of November 19 the guests were entertained at dinner by M. Hymans at the Fondation Universitaire. The celebrations were continued on Tuesday, November 20, and concluded with a banquet in the University hall, which was attended by 826 guests.

The celebrations were marked by much enthusiasm and were of an extremely hospitable character. There can be no doubt that in its new quarters the University has every prospect of a brilliant and successful future.

Archæological Excavations in Shetland

MR. A. O. CURLE gave an interesting account to Section H (Anthropology) at the Aberdeen meeting of the British Association on the excavation conducted by him during the past four years in Shetland. A low promontory projecting into the Voe which lies sheltered behind the lofty promontory of Sumburgh Head, the most southerly point of Shetland, bears on its crest the ruin of a late sixteenth century dwelling house, to which Sir Walter Scott in "The Pirate" gave the name of "Jarlshof". Beneath and all around this ruin lie numerous remains of ancient dwellings, ranging from before the Bronze Age reached Shetland in the latest phase of that culture, through the period of the brochs and their secondary buildings, to the coming of the Norsemen in the ninth or tenth century and even later, for relics found in the vicinity of foundations exposed last summer indicated for them a fifteenth or sixteenth century date.

A storm some thirty years ago exposed a range of buildings on the sea front, which were at that date excavated by the proprietor. These consisted of the remains of a broch and a series of later buildings extending probably well into the Christian era. The Office of Works, having accepted guardianship of these remains, resolved to explore the ground in the immediate vicinity, and invited Mr. Curle to direct the operations on its behalf. The work has now been in progress for a short period each year since 1931. A group of prehistoric dwellings five in number, all lying practically contiguous to one another, have been explored and apparently exhausted. A dwelling, excavated during the past summer, was found to consist of an open court some 20 ft. long and 10 ft. broad, rounded at the inner end, with lateral chambers on the sides. The paving suggested the presence of cattle inside the house, a practice followed in much later days. This was confirmed by the discovery of a whale's vertebra, fixed into a wall to furnish a loop for a tether. This dwelling had been partially broken down and then extended by further constructions in front of the original entrance. From this later building a drain had been carried towards lower ground to the south-east. Evidence of a still later period was the closing of that drain by a stairway leading to another dwelling. This second dwelling was obviously of much later construction than the first. In its turn it had had three periods of occupancy, the earliest of which was seemingly contemporary with the latest occupation of the first house. The third occupation of the second house was remarkable for evidence of the advent of artificers in bronze, who cast swords and axes in clay moulds. These dwellers closed the original entrance, which lay at the foot of the stair above referred to, and opened a new entrance at the opposite end of the house. The bronze workers used clay moulds, and, to release their castings, broke the moulds and threw the fragments over the closed entrance and into disused chambers beyond, where they lay, not on the floor level, but in the

soil which overlay them. While using bronze, the people were also employing artefacts of stone and of slate. They also cultivated grain, using a species of barley. In their mode of life they were pastoral, and seem to have drawn little from the sea except shell-fish. Adjacent to the second dwelling lies a third, which in its turn had been subjected to three different occupations. The first and the second of these occurred during the final phase of the Bronze Age in Shetland, and the last after bronze had given place to iron.

This past season, while it saw, seemingly, the termination of the excavation of the prehistoric site, witnessed the opening of a fresh epoch in the exploration of a settlement of the early Norse invaders. A house has been uncovered measuring nearly 100 ft. in length, 12 ft. in breadth at either end, and 17 ft. 6 in. in the centre, the walls of which in part still stand to a height of 3 ft.—probably not much below the original elevation, as the superstructure would be of wood and turf with a roof of timber, partially supported on posts.

Numerous relics have been found, including combs and pins of bone, pins of bronze and a remarkable collection of pieces of slate bearing lines and devices in graffito. One of these, a tablet 7 in. × 2 in., shows a Viking galley with high prow and stern, with mast and steering oar, and the crew indicated by strokes rising from the deck.

Evidence of other buildings of the Norse period has been discovered, and further exploration should produce interesting results.

Technical Aspects of Emulsions

A SYMPOSIUM on the technical aspects of emulsions, organised by the British Section of the International Society of Leather Trades' Chemists, was held on December 7 at University College, Gower Street, Prof. F. G. Donnan being in the chair, and the attendance numbering more than two hundred.

Dr. W. Clayton dealt with the subject of emulsions from the point of view of the patent literature, particular mention being made of the modern idea of 'balanced' emulsifying agents with lipophile-hydrophile groups, and several patent specifications claiming the use of a preformed emulsion as an emulsifying agent of unusual virtue. Dr. R. M. Woodman discussed the problem associated with the preparation of emulsions for horticultural spraying. The formation of opposite type emulsions with one pair of liquids and the same emulsifier, the stability to ageing and to subsequent mechanical treatment of the two types in dual systems near the common phase volume ratio, and the danger to plants arising from the use of these dual emulsion systems were some of the main points discussed.

Emulsions and emulsification in the wool textile industry were the subjects of the contribution by Dr. J. B. Speakman and Dr. N. H. Chamberlain, and it was shown that the ease of removal of thin films of oil from textile fabrics is determined by adhesion phenomena as well as by the magnitude of the oil-water interface. Dr. J. W. Corran raised some interesting points in connexion with the manufacture of mayonnaise, a typical food emulsion. Egg yolk, due to the lecithin present, is the most effective edible substance in the preparation of the emulsion, but another substance, cholesterol, antagonises this action. The superiority of fresh egg as compared with preserved yolk is due not only to hydrolytic changes in the lecithin on keeping, but also to the increased relatively unfavourable influence of the cholesterol. The mustard used in manufacture confers an added margin of stability on the product. The influence of the method of mixing, etc. was discussed at some length.

Mr. R. I. Johnson described various types of agitators, colloid mills and homogenisers used in the production of industrial emulsions. The chief factors influencing the design of homogeniser pump systems and the homogenising valve were considered and reference was made to two-stage homogenisation. Mr. R. Dorey detailed some work on the effect of the mode of preparation on the dispertion of soap-stabilised emulsions, taking as examples emulsions of (*a*) olive oil with sodium oleate and (*b*) arachis oil and potassium oleate. The results given in the form of size frequency analyses indicate that the dispersion of this type of soap-stabilised emulsion is improved if the soap is allowed to be formed *in situ* during the emulsification process.

The mechanism of emulsification was dealt with by Prof. H. Freundlich. The stabilising influence of gases on emulsions produced by ultrasonic waves is most likely a secondary effect, thin layers of gas on the surface preventing or retarding the coalescence of the droplets. Ultrasonic waves acting upon an emulsion (or a coarse suspension) in a thick-walled capillary tube cause striations owing to stationary longitudinal waves in the liquid. In the nodes of these striations large drops are formed, presumably owing to an orthokinetic coagulation of the droplets when travelling from the antinodes to the nodes. It is probable that the facts which are instrumental in the formation and destruction of emulsions by ultrasonic waves are of general importance when producing emulsions by any mechanical means.

Dr. L. A. Jordan discussed the stability of emulsions in thin films with special reference to emulsion paints of the oil-in-water type. The emulsifying agent is absorbed upon the oil-water interface, and the conditions of formation of the interfacial layer determine the ageing effects produced on emulsions. One necessary condition is adsorption in one phase and solution in the other of the emulsifying agent forming the interface, while stability is dependent upon the formation of a tightly packed orientated stable monomolecular layer.

L. G. Gabriel detailed the methods of preparing asphaltic bitumen emulsions. He mentioned that it has been established that high viscosity emulsions prepared from some bitumens are due to the presence in the bitumen of finely divided water-soluble substances which serve to produce an osmotic equilibrium between the solutions, which they form inside the dispersed bitumen particles, and the bulk aqueous phase without. This work has led to a means of varying the viscosity of such emulsions without changing the bitumen content. Emulsions in the leather industry was the subject of the contribution by W. R. Atkin and F. C. Thompson. The process of fat-liquoring consists of two stages, first the absorption of oil from the dilute emulsion, and the electrical

discharge of oil droplets, and secondly the breaking of the absorbed emulsion by acid and by basic chromium compounds in the interior of the leather.

A valuable application of emulsions to medical science was afforded by a paper by V. G. Walsh and A. C. Fraser on the use of highly dispersed emulsions in the treatment of toxæmic conditions. It dealt in the main with the practical application of the observation that if very large doses of toxin are incubated at body temperature for half an hour with olive oil-soap emulsion, they are rendered non-toxic when injected intravenously. This has been made the basis for the treatment of toxæmic conditions, and more particularly of lobar pneumonia. Other points discussed were the selective adsorption of toxin by emulsion and the administration of vaccines and certain drugs in combination with emulsion, which enabled larger doses to be given without the usual effects of overdose, etc.

H. B. Stevens and W. H. Stevens dealt with the question of rubber latex, and pointed out that much scientific investigation is still required to elucidate the facts underlying all the commonly used processes for coagulating rubber latex.

University and Educational Intelligence

BIRMINGHAM.—With the object of creating a memorial to the late Sir Bertram Windle, first professor of anatomy and first dean of the faculty of medicine in the University, Sir Charles Hyde has given £5,000 towards the cost of the new dissecting room to be built at the new medical school on the understanding that it shall be called the "Bertram Windle Dissecting Room". Sir Charles has also given £300 to found a 'Windle prize' to be competed for by students in the Department of Anatomy. In his letter to the Pro-Chancellor, Sir Charles writes: "I am glad to offer these donations as I realise that they will not only carry out the object I have in mind but will also to some extent assist in the finance of the new Medical School which is naturally causing some anxiety to the Council and to yourself."

CAMBRIDGE.—W. S. Mansfield, Emmanuel College, has been appointed director of the University Farm.

Dr. W. B. Lewis has been elected to an unofficial (Drosier) fellowship for research in physics at Gonville and Caius College.

UNEMPLOYMENT among teachers is serious throughout the United States. In a recent report by the New York City Board of Education examiners, it is stated that applicants now on the eligible list have waited so long and are presumably so rusty that new examination should be required before they are appointed. The report adds that their attitude toward education, toward society, toward life itself is unquestionably antagonistic and many have embraced a radical social and political philosophy. Among the teachers there is a prevalent opinion that the fundamental industries of providing food, clothing, warmth and shelter should be divorced from profit and be conducted solely for the general welfare, as are lighthouses, highways, parks and schools. Not only so, but their National Education Association proposes they should teach this doctrine in the schools.

Science News a Century Ago

Resources and Statistics of Nations

"Under the above title," said the *Times* on December 17, 1834, "the first part of a work which promises to be a very useful one has just made its appearance. It is the undertaking of John M'Gregor Esq. F.S.S. . . . This new work on statistics confines itself to facts, and presents to its readers a collection of tables of the physical aspect, area, civil and natural divisions of countries, population, produce of mines, of agriculture, of forests, etc.; of manufactories and fisheries etc.; military and naval forces, seaports, colonies, roads, bridges, canals and, in short, of everything connected with the science of political economy, of every nation on the globe; which tables are the result of much personal observation and of the most authentic public and private documents which are furnished by the Governments of the different countries, and by the most accurate writers by whom the science has been illustrated. . . . The work which is about to be translated into the French and German languages . . . is at once concise, perspicuous and comprehensible."

John Macgregor, the author of this work, was born in 1797 and died in 1857. He spent many years in America, in 1840 became joint-secretary of the Board of Trade in London, and in 1847 was elected M.P. for Glasgow.

Dublin and Kingstown Railway

The last railway to be brought into operation in 1834 was that from Dublin to Kingstown. The official opening took place on December 17, and on that day the *Times* correspondent wrote: "This day our Kingstown Railroad opened, under very favourable auspices, crowds thronged the offices at Westland-row and every hour a full train of carriages started 'at high pressure'. Everyone engaged in the works seems in excellent spirits at the satisfactory state of the road, engines, carriages, etc. All the machinery works well as yet, except in one particular: the springs are not sufficiently elastic to prevent sudden shocks when the carriages stop. Three or four gentlemen had on one occasion to-day their heads knocked against each other and the carriage doors, and severe contusions were the consequence. A county of Kildare gentleman's head was laid open. The majority had, however, hard Irish heads and did not mind a few knocks. The directors have prepared a splendid entertainment at Kingstown for their friends and the subscribers to the undertaking. The weather is delightful for December, and a few broken heads does not throw much damp on a scene of Irish amusement where everything else goes well."

Elections to the Royal Society

At a meeting on December 18, 1834, Sir Benjamin Brodie in the chair, thirteen additional candidates were elected into the fellowship, making a total of fifty elected in the course of the year. Their names were: the Rev. John Barlow, the Rev. James William Bellamy, William Brockedon, Thomas Galloway, Dr. Bisset Hawkins, Andrew Leith Hay, Francis Kiernan, George Lowe, Richard Owen, Benjamin Phillips, Richard Saumarez, Charles John Tynte, John Gardner Wilkinson.

The list is noteworthy for the inclusion of two candidates who afterwards each achieved the

distinction of the Copley medal, namely, Francis Kiernan (1836) and Richard Owen (1851). In medical science the former made important contributions respecting the structure of and circulation through the liver. He was one of the founders of the University of London. [Sir] Richard Owen, at the time of his election, was assistant conservator, Royal College of Surgeons, and lecturer in comparative anatomy at St. Bartholomew's Hospital. Most of his early papers were read before the Zoological Society; in 1832, however, the Royal Society published (*Phil. Trans.*) his elaborate study entitled, "On the Mammary Glands of the *Ornithorhynchus paradoxus*". Owen became first Hunterian professor (1835); and superintendent of the Natural History Department, British Museum (1856). In the "Life" of Darwin it is recorded that Owen, a strong opponent of Darwin's views, contributed "a bitter and anonymous article on the 'Origin of Species' to the *Edinburgh Review* of 1860".

The *Beagle* Leaves the Chonos Archipelago

On November 10, 1834, the *Beagle* sailed southward from Valparaiso to survey the Chonos Archipelago as far south as the Peninsula of Tres Montes. The survey occupied about a month and on December 18 Darwin wrote: "We stood out to sea. On the 20th we bade farewell to the south, and with a fair wind turned the ship's head northward. From Cape Tres Montes we sailed pleasantly along the lofty weather-beaten coast, which is remarkable for the bold outline of its hills, and the thick covering of forest even on the almost precipitous flanks. The next day a harbour was discovered, which on this dangerous coast might be of great service to a distressed vessel. It can easily be recognised by a hill 1,600 feet high, which is even more perfectly conical than the famous sugar-loaf at Rio de Janeiro. The next day after anchoring, I succeeded in reaching the summit of this hill. It was a laborious undertaking, for the sides were so steep that in some parts it was necessary to use the trees as ladders. There were also several extensive brakes of the Fuchsia, covered with its beautiful drooping flowers, but very difficult to crawl through. In these wild countries it gives much delight to gain the summit of any mountain. There is an indefinite expectation of seeing something very strange, which, however often it may be balked, never failed with me to occur on each successive attempt. Everyone must know the feeling of triumph and pride which a grand view from a height communicates to the mind. In these little frequented countries there is also joined to it some vanity, that you perhaps are the first man who ever stood on this pinnacle or admired this view."

Dundonald's Rotary Steam Engine

The *Mechanics' Magazine* of December 20, 1834, contains an illustrated account of the rotary steam engine invented by the famous naval commander Thomas Cochrane, tenth Earl of Dundonald (1775–1860): "We give a place to the present description of it in our pages," said the *Mechanics' Magazine*, "for two reasons . . . first because of the considerable talk about it owing partly to the celebrity (for other things than machine inventing) of the noble inventor, and partly to his prodigiously confident representations of its amazing capabilities, and secondly because if we are wrong in the opinion we have formed of it . . . it would be a thousand pities that the knowledge of an invention, calculated to confer so much benefit on the mechanical world, and to save so much trouble and mortification to hundreds of ingenious mechanics, who are now occupied with the solution of that problem of *which it is said to furnish the best possible practical solution*, should not be as speedily and as widely diffused as possible." Later on, Dundonald was allowed to fit one of his rotary engines in H.M. Paddle Sloop *Janus*, but it proved a failure and was removed from the ship. This engine formed the subject of one of the many reports which Airy, the Astronomer Royal, from time to time made at the request of the Admiralty.

Societies and Academies

PARIS

Academy of Sciences, November 5 (*C.R.*, 199, 897–988). JEAN TILHO: Two sketches concerning the final capture of the Lagone and its consequences for the Tchad basin. Sketch maps illustrating the author's previous communication on the same subject, and further remarks on the serious consequences which would result in the Tchad area. MARIN MOLLIARD: Heather and mycorrhiza. Results on the culture of *Calluna vulgaris* under aseptic conditions: the views of Rayner as to the necessity of the presence of a mould for normal growth are not confirmed. CHARLES ACHARD, AUGUSTIN BOUTARIC and JEAN BOUCHARD: The action of sera on the fluorescent power of solutions of uranine. The fluorescent power of uranine solutions is unaffected by the addition of normal sera (horse, man), and this is also the case with sera from subjects suffering from various diseases. The blood of cancerous patients, however, causes a marked reduction of fluorescence. JULES HAAG: Self-maintained oscillations. J. CABANNES: Theoretical considerations on the luminescence of the upper layers of the atmosphere. The luminosity of the night sky is regarded as a phosphorescence phenomenon in a gaseous mixture of metastable nitrogen, ozone, oxygen and water vapour. HENRI DEVAUX and JEAN CAYREL: The influence of temperature on the electrical conductivity of cupric sulphide in thin layers. The considerable changes in the conductivity of thin layers of cupric sulphide produced by a rise of temperature are attributed to loss of water. LUCIEN DANIEL: Deficient seeds in the grafted Jerusalem artichoke. E. J. GUMBEL: The paradox of the limit age. DAVID WOLKOWITSCH: A generalisation of a theorem of Monge. ALFRED ROSENBLATT: The application of Picard's method of successive approximations to the study of equations of the second order, elliptical and non-linear, with three independent variables. CORNELIS VISSER: The angular derivative of univalent functions. HENRI CARTAN: Pseudo-conformal transformations of the topological product of two domains. TCHANG TE-LOU: A new method for the study of detonation in the motor. It is not sufficient to measure the maximum pressure produced by the detonation: the variation of dp/dt with the time is a better measure of the shock. An apparatus is described which records the curve dp/dt as a function of time. Reproductions of four of these curves are given, showing the effect of advancing the spark. DANIEL BARBIER: The reality of the correlation observed between the eccentricities and periods of double stars. A discussion of the views

of C. K. Seyfert. From a discussion of additional data, the author can neither confirm nor deny the conclusion of the reality of this relation. RAYMOND LAUTIÉ : The density and molecular constitution of a normal pure liquid. WOJCŚECH SWIETOSLAWSKI and JOSEPH SALCEWICZ : The application of Newton's laws of cooling to the measurement of very small thermal effects. The method described has been applied to the determination of the heat produced by a specimen of pitchblende. The temperature change was of the order of 0·0034° per hour. EMILE SEVIN : Waves, spin and numbers. J. SAVARD : The ionisation potentials and energies of formation of some halogen molecules. JEAN SAVORNIN : The influence of the reflective power and sharpness of the edge of a screen on distant refraction. MLLE. C. CHAMIÉ : The supplementary radiations in the recoil of the active deposit of thorium. JULES GUÉRON : The Raman spectrum, constitution and evolution of solutions of stannic chloride. MLLE. MARIE LOUISE DELWAULLE : The system bismuth iodide, potassium iodide, water. PIERRE LOCUTY and PAUL LAFFITTE : The system sulphuric acid, ammonium sulphate, water. PICON : The preparation and properties of ammonium, calcium and quinine aurothiosulphates. A. PERRET and R. PERROT : The reactional aptitude of sodium amide. Study of the reactions of sodium amide with cyanogen, phosgene and sulphuryl chloride. CHARLES DUFRAISSE and MAURICE LOURY : Researches on the dissociable organic oxides. 1, 1-Diphenyl-3, 3-dicarbethoxyrubene. Its dissociable oxide. GEORGES DARZENS and ANDRÉ LÉVY : The fluorine derivatives of butyltoluene and of butyl-*m*-xylene. New fluoro-nitro derivatives smelling of musk. JACQUES FROMAGET : The Trias in the north-west part of the syncline of Sam Neua (Tonkin and Laos). P. ROUGERIE : The harmonic analysis of the diurnal variation of the north-south earth currents recorded at the Parc Saint-Maur Observatory. GEORGES DEFLANDRE : Microfossils of plankton origin, preserved in the state of organic matter in flints from the chalk. H. COLIN : The starch of the Florideæ. This has properties intermediate between those of true starch and glycogen. PIERRE LESAGE : The heredity of acquired precocity in *Lepidium sativum*. MLLE. JEANNE LÉVY : Experimental alcoholism. The mechanism of growing used to alcohol. From experiments on the rat it is concluded that there is no acceleration in the oxidation of the alcohol : the effect is due to a reduction in the sensibility of the cells of the brain. ANTOINE MAGNAN : Contribution to the study of flight in birds. MARC DE LARAMBERGUE : Self-fertilisation and cross-fertilisation in *Bullinus contortus*. P. CHEVEY : The vertical distribution of the ichthyological fauna near the eastern coasts of French Indo-China. JACQUES POCHON : The rôle of a cellulolytic bacterium of the stomach, in the transformation of cellulose into glucose, in the interior of the digestive tube of ruminants. It is proved that *Plectridium cellulolyticum* is an important factor in the process of digestion of cellulose in ruminants. GASTON RAMON : Experimental antidiphtheric immunisation by means of living diphtheria bacilli.

CAPE TOWN

Royal Society of South Africa, August 15. R. W. S. CHEETHAM, I. SCHRIRE and H. ZWARENSTEIN : Influence of testicular and of urinary extracts on the creatinine excretion in rabbits. Testicular extract increases the excretion of creatinine transiently in the normal rabbit by approximately 40 per cent. Testicular suspensions decrease the creatinine elimination in the normal rabbit by approximately 40 per cent. This too is a transient effect. Injection of urinary extract of the male sex hormone first decreases the creatinine excretion by 30 per cent and then increases the elimination by 30 per cent approximately. This is a diphasic effect, and passes off within four days of the injection. B. G. SHAPIRO and H. ZWARENSTEIN : Effect of hypophysectomy and castration on muscle creatine in *Xenopus laevis*. The average creatine content of the hamstring muscles of the South African clawed toad is 400 mgm. per 100 gm. Removal of anterior or both lobes of the pituitary produces a steady decline in muscle creatine. Five months after operation the hypophysectomised animals contain an average of 18 per cent less creatine than the captive control animals. Removal of the testes or of the ovaries has no effect up to five months. S. HONIKMAN, H. A. SHAPIRO and H. ZWARENSTEIN : The bio-assay of the gonadokinetic principle of the anterior pituitary. A curve has been constructed relating dosage of an acid extract of anterior pituitary (sheep and goats) to percentage response (ovulation plus oviposition) in *Xenopus laevis* during July (breeding season). Fifty animals were used for each point : they were kept at 18°–20° C. ; readings were taken twenty-four hours after injection ; laboratory age of animals did not exceed two weeks. The unit is defined as the amount of original tissue required to produce a 50 per cent response. This was found to be 3·8 mgm., that is, 263 units per gram. BENJAMIN FARRINGTON. Vesalius on china-root. Extracts from a letter of Andreas Vesalius to Dominus Joachim Roelants written at Ratisbon, June 13, 1546. At this time China-root (that is, China-smilax, a species of sarsaparilla) had an enormous reputation as a specific for various diseases. Vesalius, in lively and sarcastic style, exposes the inadequacy of the basis on which this reputation rested.

VIENNA

Academy of Sciences, Oct. 25. KARL GROBBEN : Decapod sperm and the position of Eucyphidea in the genealogical tree of the decapod Crustacea. JOSEF HARAND : Critical temperature as a microchemical characteristic. A heating block for the safe and rapid determination of critical temperatures is described. A streaming microscope is used which allows quantities of material as small as 0·1–0·05 mgm. to be employed. Prud'homme's formula for chlorine derivatives of the paraffin series is confirmed, the critical temperature of methane being calculated to be 186·6°. The values for *n*-, *i*-, and commercial butanes are given, and it is shown that a substance gaseous at the ordinary temperature may be identified and its purity determined by means of its critical temperature. Examination of binary systems is also possible. ALFRED PISCHINGER and WILLY HORNIK : Influence of indifferent neutral salts on substantive histological staining. OTTO SCHINDLER : The kidneys of the larvæ of sea fish.

Oct. 31. FRITZ RIEDER : Wilson chamber studies of the ultra-radiation on the Hafelekar (2,300 metres). With the help of Wilson diagrams, a statistics of the electrons liberated by ultra-radiation, as regards their energy and—with some degree of probability—the sign of their charge, is developed. Observations

were made also on heavy corpuscular rays, the liberation of which by ultra-radiation appears established; these have ranges of 0·6 cm. to at least 5·5 cm., calculated to 15° C. and 760 mm. pressure, but their nature and the mode of their formation remain unknown. FRIEDRICH LAUSCHER: Thermal radiation and restriction of horizon. Radiation of basins, valleys and lanes. (1) A general method for deducing the radiation from any surfaces.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, December 15

BRITISH PSYCHOLOGICAL SOCIETY, at 3. Annual General Meeting.

Sunday, December 16

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Fossil Mammals".*

Monday, December 17

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. W. T. Calman: "The Shipworm".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Discussion on "Population Maps" to be opened by Prof. C. B. Fawcett.

Tuesday, December 18

EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, W.1).—Dr. Shepherd Dawson: "Disease and Intelligence".

Wednesday, December 19

BRITISH SCIENCE GUILD, at 5 (at the Royal Society of Arts, John Street, Adelphi, London, W.C.2). Col. M. O'Gorman: "Bringing Science into the Road Traffic Problem".

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Industrial Research Exhibit: a Guide to Stands 6 to 34, Cardiff Engineering Exhibition, 1934, under the auspices of the South Wales Institute of Engineers. Pp. 20. (London: Department of Scientific and Industrial Research.)

Proceedings of the Third International Locust Conference, London, September 18, 1934. (Cmd. 4725.) Pp. 184. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Year Book of the University Catholic Societies Federation of Great Britain, 1934–1935. Pp. 96. (Glasgow: Hon. Secretary, 13 Fortrose Street.) 1*s*.

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1933. Pp. 200. (Harpenden: Rothamsted Experimental Station.) 2*s*. 6*d*.

Natural Science and Archæology Society, Littlehampton. Reports of Proceedings, 1933. Pp. 22. (Littlehampton.)

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1934; with Report of the Director of Fuel Research. Pp. vii+178. (London: H.M. Stationery Office.) 3*s*. net.

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1933–1934. Pp. 12. (Durham.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 11: The Early Stages in the Development of the Ferret; Fertilisation to the Formation of the Prochordal Plate. By Dr. William J. Hamilton. Pp. 251–278+7 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 6*s*.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-eighth Session adopted at the Annual Meeting of Governors held on the 16th October 1934. Pp. 84. (Glasgow.)

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1933–34. Pp. 36. (Aberdeen.)

A Review of the Experimental Working of the Five Days Week by Boots Pure Drug Company at Nottingham. By Sir Richard A. S. Redmayne. Pp. 70. (Nottingham: Boots Pure Drug Co., Ltd.) 1*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 13: The Measurement of the Current generated by Rectifier Photo-Cells. By H. H. Poole and W. R. G. Atkins. Pp. 133–139. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

OTHER COUNTRIES

Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert), 1932–33. Pp. v+203+4 plates. (Delhi: Manager of Publications.) 4.12 rupees; 8*s*.

The Indian Forest Records. Vol. 20, Part 11: New Termites from India. By Thomas E. Snyder. Pp. ii+28. (Delhi: Manager of Publications.) 9 annas; 1*s*.

Carnegie Institution of Washington. Publication No. 436: Contributions to American Archæology. Vol. 2, Nos. 5 to 12. Pp. iii+355+38 plates. (Washington, D.C.: Carnegie Institution.)

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Lucia, 1933. Pp. iv+51. (Castries, St. Lucia: Government Printing Office.) 6*d*.

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 2 (Items 2131–2244): April, May, June, 1934. By Ernest A. Hodgson. Pp. 27–44. (Ottawa: King's Printer.) 25 cents.

U.S. Department of Agriculture. Miscellaneous Publication No. 198: An Annotated Bibliography of the Hessian Fly, *Phytophaga destructor* (Say). By J. S. Wade. Pp. 100. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 17: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 17: The Hepaticæ (chiefly Riccia and Anthocerotaceæ) of the Galapagos Islands and the Coast and Islands of Central America and Mexico. By Marshall A. Howe. Pp. 199–210+plate 7. Vol. 21, No. 18: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 18: Lichens. By David H. Linder. Pp. 211–224+plate 8. (San Francisco.)

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1933. By Dr. W. Youngman. Pp. 184. (Colombo: Government Record Office.) 2 rupees.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3, Part 8: The Cambro-Ordovician Formations and Faunas of South Chosen—Palæontology, Part 1: Middle Ordovician Faunas. By Teiichi Kobayashi. Pp. 329–519+44 plates. 3.50 yen. Vol. 3, Part 9: The Cambro-Ordovician Formations and Faunas of South Chosen—Palæontology, Part 2: Lower Ordovician Faunas. By Teiichi Kobayashi. Pp. 521–585+8 plates. 1.00 yen. (Tokyo: Maruzen Co., Ltd.)

Meddelanden från Lunds Observatorium. Ser. 2, Nr. 67: Catalogue of Auroræ borealis observed in Northern Sweden during the Time August 1932–March 1933. By Axel Corlin. Pp. 51. Ser. 2, Nr. 68: Studies on the Stream Motions of the Stars. By W. Gyllenberg. Pp. 114. 9.00 kr. Ser. 2, Nr. 69: Analytical Theory of Regression. By S. D. Wicksell. Pp. 32. 2.50 kr. Ser. 2, Nr. 70: Studies of the Effective Wave-Lengths of Stars. First Paper: Effective Wave-Lengths of 659 Stars in Messier 37 from Plates taken at Mount Wilson. By Jöran M. Ramberg. Pp. 39. 4.00 kr. (Lund.)

Memoirs of the Commonwealth Solar Observatory. Memoir No. 4: Atmospheric Potential Gradient Observations at the Commonwealth Solar Observatory, Mount Stromlo, Canberra. By C. W. Allen. Pp. 47. (Canberra: Government Printer.)

Journal of the Indian Institute of Science. Vol. 17A, Part 8: Utilisation of Indigenous Tanning Materials, Part 1: Manufacture of Tannin Extract from Avaram Bark (*Cassia auriculata*, Linn.). By Keshaviah Aswath Narain Rao and Shaha L. Janniah. Pp. 95–104. 14 annas. Vol. 17A, Part 9: Estimation of Potassium by the Cobaltinitrite Method. By S. D. Sunawala and K. R. Krishnaswami. Pp. 105–112. 12 annas. (Bangalore.)

The Indian Lac Research Institute. Bulletin No. 19: The Heat Curing of Shellac, Part 2: "Depolymerisation". By M. Rangaswami and R. W. Aldis. Pp. 10. 1 rupee. Bulletin No. 20: Further Notes on the Use of *Schleichera trijuga* (Kusum) in Lac Cultivation. By Dorothy Norris; with an Appendix by P. M. Glover. Pp. 4. 8 annas. Bulletin No. 21: A Check List of the *Chalcidoidea* bred at Nankum from the Lac Insect *Laccifer lacca*, with some Notes as regards their Function, Economic Importance and Control. By P. M. Glover. Pp. 14. 1 rupee. (Bangalore.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. Fishes obtained by Mr. H. W. Bell-Marley, chiefly in Natal and Zululand in 1929 to 1932. Pp. 405–514. (Philadelphia.)

National Research Council: Division of Geology and Geography. Report of the Committee on the Measurement of Geologic Time, presented at the Annual Meeting of the Division of Geology and Geography, April 28, 1934. Pp. ii+86. (Washington, D.C.: National Research Council.)

Descriptive Catalogue of the Collection of Microscopes in charge of the Utrecht University Museum, with an Introductory Historical Survey of the Resolving Power of the Microscope, by P. H. Van Cittert. Pp. 110. (Groningen: P. Noordhoff.) 2.90 f.

Bulletin of the American Museum of Natural History. Vol. 67, Article 8: Chalicotheres from Mongolia and China in the American Museum. By Edwin H. Colbert. Pp. 353–387. (New York City.)

Journal of Science of the Hiroshima University, Series B, Div. 2 (Botany). Vol. 2, Article 2: Monographia Hepaticarum Australi-Japonicarum. By Yoshiwo Horikawa. Pp. 101–325+plates 11–21. (Tokyo: Maruzen Co., Ltd.) 2.10 yen.

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CONTENTS

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Political Principles and Native Affairs in Africa

DURING his recent visit to England, General Smuts, by his utterances on matters of public policy, did much to enhance a reputation which already stood high. His philosophical breadth of view and his appreciation of the gravity of the issues which need to be faced, whether he dealt with the affairs of South Africa or surveyed the situation in the world at large in relation to imperial policy, assured his position as a protagonist in any future reasoned approach to the solution of the ills of modern civilisation. If, therefore, his views on certain questions are made the occasion of comment in relation to the application of scientific principles to problems of government with which he is concerned, it cannot be imputed to him as a fault that his outlook is that of a party politician. None the less it is essential to remember that General Smuts, like other leaders in a modern democracy, must work through the medium of party machinery.

This limitation cannot be ignored in matters affecting, or affected by, the position of the native population of South Africa. Whereas in a crown colony or protectorate difficulties and problems of native life can be made the subject of impartial scientific inquiry and settled by administrative action, in the Union of South Africa they may be, and almost invariably are, brought into the heated atmosphere of everyday politics, since in some form or other in a population in which black outnumbers white by something like three to one, the native question is near to all.

The history of the native question in South Africa is largely a history of party conflict; and even now it is only slowly and partially that the results of scientific inquiry are being applied to the amelioration of conditions brought about by indifference to the study of native institutions. This renders it all the more gratifying that General Smuts should have been in a position to announce that measures are in prospect for the improvement of conditions of native life, and more particularly, that additions may be made to their lands. This last, indeed, is an urgent necessity, for which those best acquainted with native institutions and conditions have long pressed in order that the ethos of native communal life might not be denied the opportunity of full expression.

On the other hand, when General Smuts presses for the transfer to the Union of the

Protectorates of Bechuanaland, Basutoland and Swaziland, the relation of the native question to political feeling within the Union may well give pause, lest a too hasty assent be given to the transfer to a Dominion Government of native peoples who have placed themselves voluntarily under imperial jurisdiction. To suggest this is in no sense to impugn the good faith of the people of South Africa; but where the sense of the colour bar is strong, and is reinforced by an economic competition which is bound to increase, it must inevitably be difficult to ensure that it will not affect administration, even when the position and interests of the voter are not directly implicated.

On the other hand, it might be contended that the trend of native legislation in South Africa is reassuring. From 1927 it has secured throughout the four provinces of the Union the unification of principle in native administration, establishing on a firm basis respect for native institutions and the social codes of those natives who live under the tribal system; and it aims at the principle of the complete segregation of black and white—in which it has the firm support of the more advanced element in the native community. Thus it may be maintained that it provides a sufficient guarantee that the administration of the Protectorates will be no less sympathetic under the Union than it has been under the Imperial Government.

In so far as concerns the preservation of the *status quo* in the Protectorates, there can be no question that this argument carries weight. Yet there are those who, looking at the facts within the Union with the eye of impartial inquiry, point out that the policy of segregation in a practical sense is inoperative; and further, that it does not as a matter of fact provide that opportunity for the development of the native within the framework of his own tribal institutions, even though these may be modified or adapted in such a way as to train him to become a participating member in the community, which was anticipated by those who first advocated this policy.

In Africa, if anywhere, it is necessary to take long views, and neither the system of reserves for the tribalised native, nor the regulation of the detribalised population took full account of the effect which would follow from the existence of a large urbanised native and coloured element in active economic competition with the lower grade of white labour. The policy of segregation has restricted, rather then fostered, native development in certain directions. Such, for example, is the effect of legislation confining to the reserves the holding of land by natives. This has put an end to the advantageous practice of farming out the land by land-owners to native squatters on a crop-sharing basis, and in some areas has now affected adversely the amount of land under cultivation. It has also checked manual training, from which at one time much was hoped for the material and intellectual development of the native. Natives returning to the reserves can find no opportunity in tribal culture for the exercise of the skill they have acquired and, consequently, have ceased to interest themselves. Schoolmastering and the ministry virtually afford the only prospect of advancement, and here the opportunities are necessarily limited.

It may, however, be asked, to what conclusion does this tend? Admitted, it may be said, that the present position of the native within the Union is the outcome of racial conflict, both white and black races are intruders, and the Bantu have been in the country very little longer than the white man. If, therefore, we regard, as we must, the interests of a white South Africa as necessarily prevailing, this need not affect the very different conditions upon which the Protectorates will come into the Union. The answer to this contention must be that it is not sufficient that the *status quo* should be maintained. No action must be taken which in any way may prejudice the opportunity for dispassionate discussion of the lines along which the native tribes of the Protectorates may be assisted towards their future standing, whatever that may be. In present conditions their future is a part of the problem of black Africa as a whole, and its discussion lies outside the range of local political theory or prejudice. Can the same assurance be given by the Union?

The future of Africa is bound up with the fate of her native populations. A proposition so crudely obvious would seem scarcely worth statement, if it were not for the fact that it cannot be too strongly emphasised to enforce the corollary that the problem of the future of the African peoples cannot be solved without the application of the results of intensive scientific study. That contact with European civilisation everywhere is rapidly affecting native cultures and organisation is obvious; yet apart from certain private or semi-private efforts, no systematic attempt is being made to ascertain its mode or direction, or whether in the long run, if unchecked, it will

prove permanently harmful to the well-being of Africa as a whole. Only a few weeks ago it was felt necessary to direct attention in the columns of NATURE (Oct. 20, p. 585) to the urgency of an appeal from men of science and others in the daily Press to secure public interest in expenditure, small in relation to the importance of its object, upon an investigation of the mentality of the African native—an investigation by the results of which the whole future policy of native education and training may be fundamentally affected.

The proposed investigation of the mentality of the African natives was coupled with a suggestion for an inquiry into their pathology and hygiene. The urgency of the medical problem is so patent that it has overshadowed the no less urgent significance of the more purely anthropological investigation. For, as Sir Grafton Elliot Smith has pointed out, this latter is no more than a preliminary inquiry. It is, however, imperative that it should be undertaken, before it is possible to enter upon the consideration of the wider question of the interaction of the changing African and his changing environment, and the modifications in political and social organisation which that interaction must entail.

It is usual to assume—or, at least, in relation to the proposed inquiry, it has been assumed and asserted—that the African is of inferior or backward mental character. To many, however, this seems an open question, to which the inquiry, it is hoped, will reveal the full answer. In part the assertion seems to be contradicted by many well-attested facts, but for the moment discussion may be set aside. What is important to note is the fact that, so far as the anthropologist is concerned, the scientific line of approach recognises differences in culture as the product of racial history and environment without attempting to evaluate them in terms of a higher or lower mentality. Each is the adaptation best fitted to its conditions in so far as it successfully conduces to survival. For the politician, however, cultures are apt to be graded as 'higher' or 'lower' and translated into terms of race as 'superior' and 'inferior', these terms carrying with them the implication that the 'superior' race is justified in assuming control of the 'inferior'. Hence 'racial problems' and the attempts, of which the results deserve careful study, to convert the native African into a dark-skinned European, with consequences which have been far from happy, as may be seen in our older African colonies.

It is the merit of the system of 'indirect rule', and of the modifications of it which have been applied in our African dependencies, other than those of West Africa, that it has recognised differences of culture and race in the contact of African and European, and except in certain specific matters, has as a matter of principle admitted the suitability of African culture for the African at his present stage of development. It is a strange commentary on our attitude in the past to 'backward' peoples that this should not be obvious.

The special significance of the proposed inquiry into the mentality of the African is that it comes at a moment when it is becoming increasingly apparent that 'indirect rule', the reserve system and other measures of a like character, are a 'half-way house' in which the native may live for a considerable length of time, but which eventually must be evacuated. Administrative action, working with justice and sympathy, may retard that evacuation; it may dissipate the shock of social and moral dislocation inevitable as a concomitant of the change; it cannot avert it indefinitely. Whether it is to be a halfway house on the road to degradation or virtual extinction as has happened to most of the American Indians, or to a fuller development of the best of African culture in alliance with that of the white races, is a grave responsibility which rests upon those by whom the future of the African will be shaped.

In seeking the direction in which this future lies, and in estimating the trend of changing conditions in Africa, due weight must be given to the volume and direction of native opinion, which is becoming increasingly articulate at the same time as it grows in force and precision. Africa is no longer entirely plastic in the hands of the administrator. Yet both in South Africa, in the support given to segregation, and in West Africa, where the native critic tends to regard 'indirect rule' as a means adopted by the white man to keep the black man in his place, native opinion is averse from the preservation of native custom as merely static. Whether, with its co-operation, the administration may be able to foster the development of a distinctive African culture, which has absorbed such elements of European civilisation as will ensure survival, for the time being must rest on the knees of the gods. It will demand efforts strenuous and long enduring, and no less scientifically planned.

War by Poison

"Gas!": the Story of the Special Brigade. By Major-General C. H. Foulkes. Pp. xv+361+16 plates. (Edinburgh and London: William Blackwood and Sons, Ltd., 1934.) 30*s.* net.

THE use of 'gas' in war has been defended by several British and American writers on the ground that it is less inhumane than bullets and high explosives. It is pointed out that in the last years of the War, only about 3 per cent of the gas casualties of the Allies died, and the great bulk of the remaining 97 per cent made complete recoveries in a short time. General Foulkes advocates it on quite other grounds: if properly applied, he says, it causes far more casualties than any other arm, and the deaths amount to 20–40 per cent of the casualties. Consequently it offers the best means of ending a war that is settling down to a condition of protracted siege.

This great discrepancy in the mortality is due to different methods of using gas. At first, in April and May 1915, the Germans used clouds of chlorine released from cylinders installed in their trenches. They did not use them again on the British front until December because the prevailing wind was against them, but later in 1916 they made four more cloud attacks. Although the British troops were then provided with gas masks, the casualties averaged 876 in each attack, with a mortality of 24 per cent. Yet the Germans then discontinued this method, and used only shells, which caused very few casualties and scarcely any fatalities, until mustard gas was introduced.

Why did the Germans give up such an effective method? The troops disliked it, as it involved heavy labour in bringing up and installing the cylinders, and it inevitably subjected them to artillery retaliation. Then they had to wait an indefinite time, perhaps months, for a favourable wind of the right strength, and sometimes, even then, it veered round and blew the gas on to themselves. As the cloud attacks were seldom followed up, their effects were unknown, at any rate until long afterwards. The most important reason, however, was that in September and October 1915, the British replied with cloud gas attacks at Loos and the Hohenzollern Redoubt with considerable effect. The German High Command then realised that a mistake had been made in introducing this weapon on the Western Front, where the prevailing wind was against them, and in order to discourage us from continuing its use, they stopped it and suppressed all references to gas casualties in their own ranks.

From July 1916 until July 1917, the Germans fired great numbers of shells filled with non-persistent liquids, either lachrymatory (xylyl bromide, for example) or lethal (diphosgene). Neither of them caused many casualties, and the mortality was only 6 per cent, but they had some tactical value, because they forced our troops to wear their masks or drove them into the dug-outs. Then the Germans began to use mustard gas (dichlorodiethyl sulphide) and the British casualties increased enormously, but the mortality amongst them fell further to 2·5 per cent. Except the first unexpected attacks with chlorine gas, this was undoubtedly by far the most successful of the substances used by the Germans, because it affected the whole body, and persisted for a long time in consequence of its low volatility and the very small concentration that sufficed to produce casualties.

In July 1917 the Germans also began to use shells charged with a 'sternutator', diphenylchloroarsine, which, in the form of a cloud of minute particles, produces running at the eyes, coughing and especially sneezing so severe that it may render it impossible to wear a gas-mask. As the particles have no Brownian movement and the substance is a practically non-volatile solid, it is only partly removed from the air by the activated charcoal of the respirator, but fortunately the British had had warning, and consequently added a layer of cheese-cloth to the box respirator, and this filtered out the particles. The high explosive used in the German shells to reduce the substance to a particulate cloud was not effective; the particles were too large. An officer of the British gas service discovered that it is far better to volatilise it by heat, and this led to the idea of a thermogenerator in the form of a sort of smoke candle, or contained in a shell. If the War had lasted until 1919, it was intended to use them on a very large scale charged with the even more potent compound, diphenylaminechloroarsine.

The evolution of gas tactics in the British Army followed rather a different course. The Special Brigade, consisting largely of men with chemical training, showed great enterprise and initiative, but was hampered at first by the breakdown of the British system of supply by contractors. As there were not enough shells for high explosive and shrapnel, naturally not many could be obtained for gas filling, so the Brigade continued to use clouds of chlorine and afterwards of phosgene ($COCl_2$), which is much more lethal. Then the Stokes mortar was introduced, and as this fired a thin-walled shell and had a very rapid rate of fire, it was very suitable for producing the required high concentration of gas. In 1917 the Livens projector came into use, and this fired a thin-walled drum containing 30 lb. of phosgene. As the projector consisted simply of a solid drawn steel

tube $\frac{1}{4}$ in. thick, it could readily be manufactured in large quantities. A large number of them were simply buried in the ground up to their muzzles and fired simultaneously by electricity. Thus a high concentration was suddenly and unexpectedly generated in the enemy trenches, and the casualties and fatalities were severe. The Germans also adopted the projector, but they failed to understand that the drums must be of large capacity and that they must be used in large numbers in a limited area.

In the British service, the technique of the gas cloud was improved by the introduction of the 'retired cylinder' method of attack. The inconvenience and danger of installing the cylinders in the front line trenches were avoided by placing them some 600 yards to the rear, either in trucks on a light railway, or carefully camouflaged. As the clouds penetrated with the wind to a depth of 12 miles or more, this did not interfere with the effectiveness, but it was of course necessary to withdraw our troops for a time from the trenches in front of the cylinders. This device was to have been tried on a very large scale in 1918, but was prevented first by the German attack in March, and afterwards by the advance of the Allies, which did not allow of the necessary arrangements being made. Nevertheless, a number of smaller gas attacks of this sort were made, and appear to have been very successful.

This is the best book that has been published on gas warfare. It does not profess to deal fully with the chemistry, physics or physiology, but it does discuss at considerable length the tactics of gas attacks, which is of fundamental importance. Much of the matter has not appeared before, and the book is illustrated not only by numerous photographs but also by maps of the Western Front prepared by the Ordnance Survey. General Foulkes, as Director of Gas Services, was able to collect information about the German gas casualties which throws an entirely new light on the subject. It is evident, however, that he is less interested in defence, and although he mentions the various types of gas-mask that were used during the War, he makes no allusion to the great improvement that has been effected since 1918. The present mask of moulded rubber is so comfortable that it can be worn indefinitely without diminishing seriously the fighting value of the troops, and this must have a great effect on the gas warfare of the future.

In his enthusiasm, General Foulkes is inclined occasionally to forget the limitations of gas warfare. After the Armistice he went to India to advise the Government there, and to study the possibilities of gas in frontier fighting. He says: "Here, of course, gas would be particularly valuable, as the fighting consists largely of a struggle for hill-tops, the evacuation of which can be forced by a very small expenditure of gas ammunition." Surely a bare, rocky hill-top under a scorching sun is very unsuitable for the production of that high concentration of gas upon which the author insists.

General Foulkes discusses somewhat briefly possible gas attacks upon the civil population in future wars. He says: "While fully admitting the grave dangers to cities of attacks from the air I do not believe that gas in bombs or in the form of spray would inflict anything like as much loss of life as H.E. . . . I might point out that the conditions in a town are very different from those on the battlefield: houses, for instance, if their occupants are taught to use them properly, can be made tolerably safe places of refuge against gas [for some further information on this, see J. Davidson Pratt, *Chemistry and Industry*, Oct. 19, 1934], whereas they increase the effect of H.E. owing to the danger of falling masonry and outbreaks of fire." Everyone who has really studied the matter will probably agree with this statement.

"Is it worth it?" is the question which Field-Marshal Lord Cavan asks in the introduction, but this raises the further question: Is gas warfare really worse than war by high explosive, or even than fighting with sword and spear on the same scale? What we have to abolish upon our developing globe is war, not war by poison.

ARTHUR MARSHALL.

Resonance Radiation

Resonance Radiation and Excited Atoms. By Prof. Allan C. G. Mitchell and Prof. Mark W. Zemansky. (Cambridge Series of Physical Chemistry.) Pp. xvi+338. (Cambridge: At the University Press, 1934.) 18*s.* net.

THE fundamental phenomenon with which this book is concerned, namely the re-emission of absorbed radiation without change of wave-length, would appear to be one of the simplest of atomic processes. No doubt it is, but before reliable information regarding the individual atom can be obtained from the observations, a great many difficulties, both experimental and theoretical, have to be overcome. For example, since the results are largely dependent on the intensity distribution of the existing radiation, a suitable source, satisfying certain rather exacting requirements, is essential. The pressure of the absorbing gas is another important factor. If this is too high, complications arise owing to atomic collisions and re-absorption of the resonance radiation. If, on the other hand, it is too low, the resonance radiation will be too weak to observe.

The existence of metastable levels, the presence of foreign gas, the hyperfine structure of the levels and the influence of magnetic and electric fields are other factors of which account may have to be taken.

A great deal of experimental work has been done in this field, but in view of the difficulty of interpreting the observations, it is not surprising that some of the results have been inconclusive and even mutually contradictory. Progress has undoubtedly been hampered also by the lack of any comprehensive survey of the subject and by diversity of notations. The present volume appears therefore most opportunely and meets the requirements of the situation in an altogether admirable manner. The authors are both active and successful research workers, and their treatment of the subject is authoritative and critical. It is also comprehensive, ranging over such a variety of topics as to preclude even a mere enumeration of them in a brief notice. Some idea of the kind of problem discussed may be obtained, however, by reference to a few of the more important, such as, for example, the contours of absorption lines, methods of estimating life times of excited atoms, phenomena associated with atomic collisions, and the polarisation of resonance radiation.

The presentation is interesting and lucid. Each chapter is provided with a bibliography, and there are thirteen appendices containing mathematical derivations and tables. The index appears adequate and a careful scrutiny failed to disclose more than two very trivial misprints. The authors are to be congratulated upon the conspicuous success of their undertaking; they have not only produced a valuable record of scientific achievement but in addition have ordered and systematised the subject in a manner which will be of the greatest assistance to future endeavour. W. E. C.

Sir Robert Morant

Sir Robert Morant, a Great Public Servant. By Dr. Bernard M. Allen. Pp. ix+318+4 plates. (London: Macmillan and Co., Ltd., 1934.) 12*s*. 6*d*. net.

ENGLAND has known that in Morant she had a great public servant, but how large had been his contribution, towards legislation and through administration, to the progressive development of the social services of education and public health was scarcely known beyond his intimate friends and colleagues and keenest critics.

Dr. Allen tells the story in four chapters of quiet and attractive language and judicious appreciation without apparent restraint or exaggeration, trusting to the cumulative effect to give a full picture of his subject. Each chapter records great achievement but ends in disaster. In Morant we see no trained disciple, but one of Nature's giants endowed with the sentiments and zeal of a missionary, and the steel of his character edged on the rough grindstone of hard circumstances and passionate opposition. The first is a fascinating chapter of boyhood and youth at Winchester and Oxford; of straitened means; of a young man on whom the shadows of life were already making an indelible impression and inciting to high endeavour, and of the fading away of cherished hopes of social service through the Church of England.

"Siam" is less attractive but none the less necessary. Although the chapter closes with the temporary crushing of Morant's spirit, his responsibilities, his insight into the 'perplexities and confusions' of high policy in a troubled State, the jealousy which at length gathered round him, and above all his isolation, seem a preparation, better than he could know, for the gigantic task that was maturing for him at home—a strengthening of his natural capacity to stand alone against tremendous odds.

Morant sought and obtained a humble post in the Education Department. Within seven years he became the permanent head. With dynamic energy he had thrown himself into the confused situation, mastered the facts, made his knowledge and power indispensable to ministers promoting legislation and settled his own mind as to what England needed. He urged the necessity of an expert central authority for the whole of our educational system, and localised "guidance of brains" (the local education authorities) to watch, consider and advise upon educational arrangements of all grades and of every type. In his brilliant fight for legislative authority for these latter objects and to save the non-provided schools, Mr. Balfour and his powerful adviser drew on themselves the opposition of almost the whole Liberal party, of the forces of Dissent and of the resisting school boards and their supporters, concentrated in the House of Commons in another great Parliamentary fighter—Mr. Lloyd George. But they succeeded, though not perhaps to their entire satisfaction.

In administration it was the same—boundless energy and new lines of development. The occasion of a slip, however (the Holmes Circular), gave his opponents their chance and they brought him down. Morant was transferred to the Local Government Board and by the whirligig of circumstances found himself the formidable adviser of the outstanding opponent of the Education Bill, who was reconstituting the service of public health. But he had spent his wonderful energy and succumbed to a swift attack of septic pneumonia.

Morant's mistakes have no part in the lasting influence of his great services. R. B.

Short Notices

Bentley and Driver's Text-Book of Pharmaceutical Chemistry. Revised by Dr. J. E. Driver. Second edition. Pp. xv+538. (London: Oxford University Press, 1933.) 16*s*. net.

THE second edition of this book was rendered necessary by the publication of the 1932 "Pharmacopœia", and is a great improvement on the first edition. The book consists of an introduction, a section on analytical methods, one on inorganic compounds, one on organic compounds and an appendix.

The best two chapters in the book, in the section on analytical methods, are those written by Dr. Prideaux and dealing with hydrogen ion concentration and the methods for determining it. It is not often that this subject is dealt with in such a clear and lucid manner. In the description of the methods of analysis of carbon compounds there are one or two omissions. No mention is made of accelerators for the Kjeldahl method for nitrogen and the only method described for halogens is that of Carius, though the "British Pharmacopœia" uses the method of Piria and Schiff for trichloracetic acid.

The reviewer has found that students of pharmacy have generally a limited knowledge of organic chemistry, and to the majority of them this is the most difficult part of pharmaceutical chemistry. One of the stumbling blocks is the correct understanding of the ethylenic linkage, for unless this is very carefully explained, they imagine it to be a strong point, instead of a weak one in a chain of carbon atoms. It would have been a great help if a short description of Baeyer's strain theory could have been incorporated in the chapter dealing with unsaturated hydrocarbons.

The chapter on glucosides contains no reference to the digitalis group or to the newer term 'glycosides'. The article on vitamins gives a fairly good idea of the present position regarding these substances, but implies that the sterols are the only unsaponifiable alcohols. Bibliographical references are given at the foot of each page and these should prove useful to those students desiring further information. The illustrations are numerous and for the most part useful.

It is stated in the preface that the book is a textbook for those studying for the examinations in pharmaceutical chemistry of the Pharmaceutical Society and similar examinations. As such it fulfils its mission. S. G. S.

Erinnerungen: Bekenntnisse und Betrachtungen. Von Gottlieb Haberlandt. Pp. vii+243. (Berlin: Julius Springer, 1933.) 10.80 gold marks.

THIS little book, as its sub-title suggests, comments in fresh and lively fashion upon the topics that pass inevitably in review in these reminiscences of eighty years spent largely in the service of botany in Germany. They thus reveal in pleasant fashion the striking personality of its author, who is best known in England as the author of "Physiological Plant Anatomy".

It is amusing thus to learn that Haberlandt became a botanist in the first place because the external appearance of Julius Wiesner's college in Vienna for the study of anatomy and physiology of plants was more attractive than that of the college in which studies of German language and literature were proceeding, and secondly because the necessary dissection made the study of structure in the animal world less congenial. In his early days, the great textbook of Sachs makes the strongest impression, but the young doctor does not go to Würzburg but to Schwendener at Tübingen, whose monograph upon the mechanical principle in the anatomical structure of Monocotyledons has just appeared. Thus early is made the link between structure and functional performance, and this line of thought is developed after Schwendener's removal to Berlin, during years as *Privatdocent* first at Vienna and then at Graz. Here appeared the "Physiological Plant Anatomy" upon which Haberlandt's fame largely rests, though with his transference to Berlin in 1910 as successor to Schwendener, a second period of activity began in which developmental physiology was more prominent. To this period belong the studies of the physiology of cell division which are still profoundly influencing botanical development, though his early suggestion of contributory 'hormones' is now giving way to less definite suggestions of 'growth substances', of which the Utrecht school would restrict the influence to an effect upon cell extension.

Many a botanical reader outside Germany will be grateful for the opportunity thus presented to share, even in this one sided way, in a discussion with Haberlandt of topics which remain of perennial interest wherever botanists are gathered together.

Field Studies in Ecology. By Dr. R. Bracher. Pp. 100. (Bristol and London: J. W. Arrowsmith, Ltd., 1934.) 2*s*. 6*d*. net.

THIS little book on practical work in connexion with plant ecology will be found very useful alike to students and to teachers of botany. Her experience in conducting field work in connexion with the University of Bristol has enabled the author to condense in a small compass all that is essential in a practical study of ecological problems. This she sets forth in a clear and concise manner, with suitable illustrations and with practical hints on methods of investigation, on mapping and on determining the various factors which influence the vegetation: light, atmospheric and soil moisture, acidity or alkalinity of the substratum. The synopsis of British plant communities in the earlier part of the volume is exceedingly well arranged and cannot fail to give the student a very clear account of the various plant communities and their constituent plants. The book can be warmly recommended to prospective students of ecology both in schools and at the universities as a handy guide to their practical studies.

Pyramid Prophecy

It is now ten years since Mr. David Davidson published his first book on prophecy made from the measurements of the Great Pyramid of Gizeh. That book is now in its fifth edition, and has been followed by eight smaller publications, all of which have been given wide publicity in the public Press, through full-page advertisements and otherwise.

The latest pamphlet, a quarto of seventy pages, is entitled "The Hidden Truth in Myth and Ritual and in the Common Culture Pattern of Ancient Metrology" (Leeds: The Author, 47 Park Square; London: Williams and Norgate, Ltd., 1934. 2*s.* 6*d.*); and metrologically the chief contention is that the various systems of measures in the ancient world were all derived from one system invented "to form a standard basis of reference for the many loosely formulated primitive systems of measures". If this were the case it is an important discovery. But unfortunately we stumble immediately against an astonishing series of statements, such as the following: "Surely, however, a 'widespread . . . diffusion of customs and institutions' necessarily implies widespread commercial intercourse; and does not the latter postulate the need for a standard system of measures as a common basis for exchange and barter?" It seems strange that such a sentence could ever have been written in a world where the pound and the dollar fluctuate as they do, and the metric system has not yet been adopted by the English-speaking countries.

The essential point is that all primitive measures were based on a 'primitive inch' invented by Mr. Davidson and equal in length to 1·0011 British inch. The method by which this is proved is interesting. A passage in Horapollo ("Hieroglyphics", 1, 5) reads: "To represent the current year they (i.e., the Egyptians) depict the fourth part of an aroura; now the aroura is a measure of land of an hundred cubits. And when they would express a year they say a quarter." Mr. Davidson states that the reason why the quarter-aroura represented the year was that its circumference, if circular, would be equal to 3652·42 of the primitive inches which he has invented. This is taken to prove the existence of the primitive inch; and Sir Flinders Petrie is rebuked in heavy type for refusing to believe it.

Actually, however, Mr. Davidson is demonstrably wrong. The meaning of the passage in Horapollo is this: The Egyptian word for the quarter-aroura is *ḥsb*; and in classical Egyptian the word for the current year is spelt *ḥa·t-sp*, where *a* represents alif, and *t* is the feminine ending which was dropped in pronunciation in the third millennium. This word *ḥa·t* occurs in Coptic as *ha-* or *hi-*. Horapollo plainly means that in his time the two words *ḥsb* and *ḥa·t-sp* were pronounced the same; and all exponents of Egyptian morphology will support this explanation.

The point, however, on which Mr. Davidson lays greatest stress is the pyramid's "Displacement Factor". This is derived from his theory (for which there is no evidence) that the pyramid in building fell short of its intended measurements, by an error. Of the most accurately built ancient building in the whole world this is impossible to believe. It is further stated that in consequence of this error the pyramid was left incomplete at its top platform, as it was found that the apex-pyramid or cap-piece was too big to fit. There is, of course, no evidence of the existence of this cap-piece; and it is incredible that Khufu would have left his pyramid incomplete because the original cap-piece did not fit. He would simply have ordered a new one.

The error is said to have happened thus. Fairly early in building, the few casing-blocks that survive were laid in the middle of each side to guide the workmen. Of those that were added later, and have perished, Mr. Davidson says that they tapered until at the corners they were only half the correct thickness. Now this could never have happened by mistake; for the stones would not have fitted unless they were specially graduated; and that it did not happen has been shown by Sir Flinders Petrie ("Pyramids and Temples of Gizeh", p. 84): "On all the casing, and on the core on which the casing fitted, there are lines drawn on the horizontal surfaces, showing where each stone was to be placed on the one below it. If the stones were merely trimmed to fit each other as the building went on, there would be no need to have so carefully marked the place of each block in this particular way." These points, with the corner sockets, prove that the casing was deliberately planned and there can have been no error. The "Displacement Factor" therefore falls to the ground.

Naturally we begin to ask: Why should the Great Pyramid demonstrate the fate of Britain and the Lost Tribes when it has no connexion with either? Mr. Davidson makes the connexion by inventing "Proto-Hebrews" who are said to have instructed the Egyptians in the building. There is no evidence for them; but that does not, of course, influence the belief of Mr. Davidson and his followers in them.

Anyone who may still wonder whether Mr. Davidson's book actually explains a divine revelation should open the volume at random ; he will find endless numerological jugglings and fictitious lines drawn in the pyramid. What Divine Being ever conceived descended to such puerilities? Truth, on the other hand, is known by its simplicity. For Christians the Bible is good enough, without seeking for guidance in the structure of the Great Pyramid. But since Mr. Davidson quotes from the Bible in support of his theories, it is quite fair to quote against him from St. Mark's Gospel, xiii, 22: "For there shall arise false Christs and false prophets, and shall shew signs and wonders, that they may lead astray, if possible, the elect."

RUPERT GLEADOW.

Modern Street Lighting

IN his presidential address to the Junior Institution of Engineers delivered on December 14, Mr. C. C. Paterson chose as his subject "Modern Street Lighting", laying stress on the necessity of making roads safe for traffic. It is important to remember that the number of licensed road vehicles in Great Britain has more than doubled during the last ten years. Even with the reduced maximum speed of 30 miles an hour in street lighted areas, good illumination is required for safe driving during night time. The great source of danger is that the eye has to function in conditions in which there is so little light. The eye sees by contrast either of colour or brightness. If everything were of the same colour and uniformly bright, and the visibility of the atmosphere were perfect, it would be impossible to distinguish objects from their backgrounds as there would be no contrast.

The illumination produced by bright sunshine is of the order of 8,000 foot-candles. On an overcast day, daylight falls from about 700 f.c. to 100 f.c. just before dusk. About half an hour after the sun sets, the illumination is about 5 f.c. At this point a number of drivers switch on their lights, and about ten minutes later when the illumination is 2 f.c. about 60 per cent of the cars have their lights on. When the illumination falls to 1 f.c. seeing is bad and car sidelights are beginning to glare. As the light falls to 0·1 f.c. the contrasts which give such good discrimination in full daylight are very slight, and the elements of the retina which give us the sensation of colour are weakening in their action. A man with a brown jacket and grey trousers now appears to have clothes of a uniform dark colour, but we are unable to say what colour it is. The dark grey lorry which can be seen clearly by daylight against a somewhat lighter grey road surface now disappears, as the contrast is not sufficient.

The problem of good street lighting is to find how to make the contrasts sufficiently distinct. For good seeing, the maxim is to make contrasts as distinct as possible, and this leads to the simple rule "make the road surface as bright as possible". Street lamps from this point of view should not be designed to light up objects on the road, but the road itself. Objects on the street are usually seen as dark things against a bright background, and this is the effect which street lighting should enhance. It is often true that when we drive behind a motor headlight, we see because its horizontal beam lights up the object itself rather than the road. But this projector beam is 20–30 thousand foot-candles, which is many times greater than would be possible under good street lighting conditions. For general street lighting, it would, taking expense into account, be impossible to make the objects brighter than the street.

The first step towards improving lighting is to make the road form a light background by means of its polish or shiny nature. Light can be directed on to the road in such a way that it reflects like a mirror. It does this when the light is directed along the road instead of on it. It is surprising what unpromising materials reflect light in this way. An asphalt road surface well polished by traffic reflects light excellently. A rough non-skid road surface does so also in a less degree. It is the same kind of effect as that produced by the moon when it shines towards us over water. Fortunately, as roads are at present surfaced, the conditions are often ideal for securing an uninterrupted bright path of light along their whole length. For an expenditure of three watts per foot run of road, we can obtain an illumination of 0·5 f.c. as seen on a white surface.

The two guiding principles used in modern street lighting are increasing the road brightness by specular (mirror) reflexion and increasing it by diffuse reflexion. The modern designer uses street illumination only as a rough guide to find the total amount of light available in the street. It is little use to specify road lighting by means of the 'minimum' illumination produced. Judging, as is usually done, the relative merits of two systems of lighting by the 'minimum' illumination produced is sometimes quite misleading. The real criterion is to find out which yields the highest road brightness with a given street surface condition.

If a road is so wet as to be like a still sheet of

water, very little light is diffused, the chief road brightness coming apparently from the image of the lamp. So far, means have not been found of rendering visibility anything like as good under wet as under dry conditions.

The use of a large quantity of light merely to claim compliance with a higher class of specification of the British Standards Institution without ensuring that it gives a proportionally higher road brightness is wasteful. Competition in illumination is useless, but competition in road brightness is of real value and importance. However, it is inadvisable to skimp the light and reduce its amount to the minimum required for the road surface. A certain amount of light on buildings and fences makes a great difference to the appearance of the lighting effect and sometimes aids visibility.

Mr. Paterson's address contains much novel matter, and it looks as if our ideas on street lighting would be considerably modified in the next few years. To all who drive motor-cars or ride bicycles, a good road brightness is essential as safety depends on it. Only in this way can we safely eliminate the use of headlights and the risky situations which arise from their use on busy roads.

Polarimetric Methods in Chemistry*

By PROF. T. M. LOWRY, C.B.E., F.R.S.

ARREST OF MUTAROTATION

FURTHER fortuitous observations showed that the mutarotation of nitrocamphor is not an independent intramolecular process, but depends on extramolecular circumstances, since under favourable conditions it may be arrested more or less completely over a period of several days. This discovery (which was made more than twenty years before Kurt Meyer's experiments on the aseptic distillation of ethyl acetoacetate in alkali-free vessels of silica glass) was also the result of a fortunate accident. The mutarotation of a solution of nitrocamphor in chloroform had been followed to completion during a period of about eight days, but had been accompanied by some loss of solvent (and possible concentration of the solution) by evaporation. The remainder of the solution had been left in the small graduated flask in which it had been prepared, and there was no reason to suspect that it would behave in any respect differently from the sample in the polarimeter tube. It was therefore a great surprise when, at the end of seventeen days, on attempting to confirm the *final* reading, it was found that the residue in the flask gave a rotation almost identical with the *initial* reading recorded more than a fortnight before. The transfer of the solution to the polarimeter tube, however, sufficed to initiate the mutarotation, which then proceeded with the same velocity as before.

Nearly ten years later, a further series of experiments was being made on the catalysis of mutarotation by acids and bases. It was then observed that solutions of nitrocamphor in chloroform, to which trichloracetic acid had been added, developed an intolerable and pungent odour. This observation showed that the peculiar inertness of chloroform was due to its oxidation to carbonyl chloride or phosgene, and to the consequent elimination of traces of nitrogenous bases, in the form of inert carbamides. The same series of experiments had already shown that some of these bases have an amazing catalytic activity. Thus an acceleration of mutarotation was detected as a result of adding piperidine to benzene in the proportion of 1 part of the base in 10 million parts of the solvent. This acceleration was also one of the earliest examples of a phenomenon which has since become very familiar, namely, a catalysis by bases, which could not be attributed to the presence of hydroxyl ions, and was therefore outside the scope of the conventional theories of catalysis by acids and bases, as developed and used by Ostwald and his colleagues.

An immediate sequel to this discovery was the arrest in silica vessels of the mutarotation of solutions of nitrocamphor in benzene and in ether, to which traces of an anticatalyst had been added. Subsequent experiments showed that mutarotation could also be arrested in solutions of tetramethylglucose in chloroform, benzene, ethyl acetate and pyridine ; and Owen developed to a fine art the process of arresting, almost at will and with very few failures, the mutarotation of solutions of tetra-acetylglucose in dry ethyl acetate.

The climax of this work was reached when Faulkner found that the mutarotation of tetramethylglucose could be arrested both in cresol and in pyridine, but proceeded too rapidly for convenient observation in mixtures of these two solvents. Since these mixtures gave velocities of mutarotation which were much greater even than in water, it was clear that the essential factor in promoting mutarotation was not an oxygenated solvent, or an ionising solvent (as had been suspected at earlier periods), or even the ionisation

* Continued from p. 921.

of the sugar by an acid or basic catalyst (as most other workers had assumed), but that an amphoteric solvent must be provided to serve as a complete catalyst for the process.

PROTOTROPY

The migration of a hydrogen atom, in compounds such as nitrocamphor and the sugars, was thus shown to depend on the addition and removal of a proton at two opposite poles of the organic molecule. Since no satisfactory name had been adopted for this important group of isomeric changes, I proposed in 1923 to describe them by the term *prototropy*. The migration of a proton was, however, regarded as only a special example of the more general phenomenon of *ionotropy*, in which a radical migrates from one part of a molecule to another either as an anion or as a cation. The addition and removal of the ion from the two poles of the organic molecule may be either simultaneous or consecutive, but in either case it leaves behind a positive or negative charge. In order that this type of isomeric change may proceed, it is essential that these opposite charges should be neutralised. The electronic theory of valency allows us to recognise that this is done by the rearrangement of bonds which accompanies prototropic change, since a valency electron is thereby transferred *through the interior of the molecule*, to neutralise the charge of the proton, which is transferred *through the amphoteric solvent*.

The migration of a hydrogen atom, to which the most fertile types of mutarotation are due, was thus linked up to an extended definition of acids and bases, which I set out in 1923, at a time when it must have been in the minds of many other workers, and which was described more fully by Brönsted a few months later. Thus, if we define an acid and a base as a proton donor and acceptor respectively,

$$B + HA \rightleftharpoons \overset{+}{B}H + \overset{-}{A}$$

where B is the base and HA the acid, the migration of a proton in a prototropic compound under the combined action of a base B and an acid HA can be expressed by the equation

$$B + HS + HA \rightleftharpoons \overset{+}{B}H + SH + \overset{-}{A},$$

used by Brönsted and Guggenheim, where HS and SH represent the two isomeric forms of the substrate.

The process of isomeric change, as set out above, can be regarded as an electrolysis of the organic molecule between positive and negative poles, provided by the acid and basic components of the amphoteric solvent. This mechanism has therefore been described as an "electrolytic theory of catalysis by acids and bases". Similar conditions, however, prevail in all conjugated systems, and these can now be formulated in general terms, as systems in which opposite charges at the ends of the system can be neutralised by a migration of valency electrons through the system.

ROTATORY DISPERSION

At the time when the earlier measurements of mutarotation were made, it was customary to measure the optical rotations of organic compounds only for the yellow sodium line. Work on rotatory dispersion had indeed been suspended almost completely since the death of Biot in 1862, and the discovery of the Bunsen burner in 1866. It was, however, certain that little progress could be made in elucidating the origin of optical rotatory power, or in predicting its magnitude, until the values of the rotatory power were known over a wide spectral range, instead of for a single casually determined point on the curve of rotatory dispersion.

The ignorance then prevailing in reference to this important aspect of the subject is shown by the fact that, when Drude wished to test his equation for optical rotatory dispersion, he was only able to make use of data for quartz, since the rotatory dispersion of no one of the hundreds of optically active compounds prepared and studied by organic chemists was known with sufficient accuracy to be used for this purpose; and his equation for magnetic rotatory dispersion was tested on data for five wave-lengths only, for carbon disulphide and for creosote.

Experiments carried out in order to supply the data required to determine the form of the curves of rotatory dispersion in organic compounds soon led to definite conclusions. Thus in 1913 I was able to show, with T. W. Dickson, that the optical and magnetic rotations of many simple organic compounds for eight wave-lengths in the visible spectrum could be expressed by *one* term of Drude's equation:

$$\alpha = k/(\lambda^2 - \lambda_0^2).$$

In the following year we found that *two* terms of opposite sign:

$$\alpha = k_1/(\lambda^2 - \lambda_1^2) - k_2/(\lambda^2 - \lambda_2^2),$$

could be used in the same way to express the anomalous rotatory dispersion of ethyl tartrate. This result confirmed the conclusion reached at a much earlier period by Biot and by Arndtsen, that anomalous rotatory dispersion has its origin in the superposition of two partial rotations of opposite sign and of unequal dispersion. These partial rotations may be due to very diverse

causes, ranging from the presence of two optically active absorption bands in the same molecule, to the case in which two liquids of opposite rotatory power and unequal dispersions are arranged in series in separate polarimeter tubes. This diversity has resulted in a certain amount of controversy as to the *origin* of the partial rotations which give rise to anomalous rotatory dispersion, but the essential facts represented by Drude's equation are established beyond dispute.

SIMPLE AND COMPLEX ROTATORY DISPERSION

On the basis of observations such as these, we proposed to describe as *simple* those rotatory dispersions which can be expressed by one term of Drude's equation, and as *complex* those which cannot be so expressed.

This classification is more fundamental than the earlier classification of those rotatory dispersions which increase progressively with decreasing wave-length as *normal* and of those which exhibit an inflexion maximum or reversal of sign as *anomalous*. Thus, no progress can be made in studying the optical rotatory power of organic compounds until the observed *total rotations* have been resolved into their component *partial rotations*. On the other hand, the distinction between normal and anomalous rotatory dispersion in compounds such as ethyl tartrate depends only on the relative magnitude of the two rotation constants, k_1 and k_2, of a Drude equation with two terms of opposite sign.

In general, simple rotatory dispersions are only observed when the characteristic frequencies of all the partial rotations lie close together in the Schumann region, giving a dispersion ratio $\alpha_{4358}/\alpha_{5461} = 1{\cdot}6$ approximately. Thus, in the sugar series, the partial rotations associated with the nine asymmetric carbon atoms of cane-sugar give rise to a simple dispersion; but this is not always so, since even in a sugar the characteristic frequencies of the radicals may cover a wide range in the Schumann region, and the foot of the absorption bands often extends into the ordinary ultra-violet.

ROTATORY DISPERSION IN ABSORBING MEDIA

Additional partial rotations of lower frequency give rise in the region of transparency to complex or anomalous rotatory dispersions. In the region of absorption they give rise to the remarkable anomalies which have been known since 1896 as the *Cotton effect*. These anomalies are much more dramatic than those observed in the region of transparency in compounds such as ethyl tartrate. Thus the specific rotation of camphor vapour, which is only about 55° in the yellow visible region, rises rapidly to + 2,000° on entering the region of absorption, then passes through a zero value at about 3000 A. and finally falls to a negative maximum of about − 1,800° before emerging from the absorption band.

In the remarkable case of tetra-acetyl-μ-arabinose, $H[CHOAc]_4.CHO$, the partial rotations associated with the three asymmetric carbon atoms cancel out. The whole of the rotatory power is therefore due to the partial rotation associated with the carbonyl group. This gives rise to a symmetrical loop, with equal and opposite maxima $[\alpha] = \pm 1{,}200°$ on either side of a zero rotation at 2909 A. The form of this loop cannot be expressed by Natanson's form of Drude's equation, in which the width of the absorption bands was attributed to a 'damping factor'. It can be represented, with a maximum deviation of 200°, by the equation of Kuhn and Braun, who assumed a probability distribution of *frequencies* in the absorption band; but this deviation is reduced to 30° by using the equation of Lowry and Hudson in which the absorption is distributed symmetrically on a scale of *wave-lengths*.

INDUCED DISSYMMETRY

The existence in camphor and its derivatives of a partial rotation having the characteristic frequency of the ketonic absorption band was attributed by Lowry and Walker in 1924 to the *induced asymmetry* (or better *induced dissymmetry*) of the carbonyl group. According to this conception, the symmetrical carbonyl group becomes dissymmetric under the influence of the unsymmetrical field of an optically active molecule, when coupled sufficiently closely to an asymmetric carbon atom. It therefore contributes directly to the optical activity of the molecule, whereas less polarisable groups, such as $>CH_2$ or $>CMe_2$, contribute relatively little to the total rotation, even when they are exposed to a similar dissymmetric field.

This hypothesis has received support from the molecular theory of optical rotatory power, recently developed by de Mallemann and by S. F. Boys. According to their theory, optical rotatory power in a region of transparency depends on a product of four refractivities divided by the square of the wave-length of the light. It has been shown that this theory can only be extended to the region of absorption by postulating an additional centre of dissymmetry within the chromophoric group in optically active aldehydes and ketones. This extension is in harmony with the conception of induced dissymmetry, which thereby receives important confirmation.

Obituary

Baron de Gerlache

ADRIEN DE GERLACHE DE GOMERY died in his sixty-ninth year on December 4. When a young lieutenant in the Belgian navy, he conceived the idea of organising an expedition of his own to explore the antarctic regions and had his plans complete in 1894 for a voyage of adventurous discovery. Before he succeeded in raising the very modest sum needed to purchase and equip the *Belgica*, he was induced to make scientific research the main object of the expedition, and with this in view he secured the voluntary help of a group of enthusiastic young specialists including Prof. H. Arctowski as geologist and Dr. F. A. Cook, the only member with polar experience, as surgeon. Roald Amundsen was first officer and the crew was half Belgian and half Norwegian. The *Belgica* sailed in August 1897 and spent some time amongst the islands of Tierra del Fuego, not reaching Hughes Gulf on the coast of Palmer Land until January 23, 1898. Here Gerlache discovered the strait which now bears his name cutting off three large islands from the northern extension of Graham Land. He explored and charted the coasts of this strait and large geological and natural history collections were made. The commander and his scientific staff were now at cross-purposes. He aspired to push on, perhaps to the Pole; they were anxious to remain investigating the rocks and glaciers, birds and marine organisms of a region never before touched by science. The ship went on.

Fast ice prevented any approach to the southern part of Graham Land, and the *Belgica* was headed south-west in an endeavour to reach a high latitude. Gerlache entered the pack early in March, too late in the season, and was unable to extricate the ship, which was frozen in. Thus, contrary to his plan, Gerlache was committed to the first wintering in the antarctic regions, for which the ship was ill-prepared and the provisions unsuited. During the year that followed, the *Belgica* drifted in all directions with the pack, sighting no land but making valuable soundings. The health of all on board suffered greatly, and Danco, one of the scientific staff, died of exhaustion. Before this drift, nothing whatever was known of winter conditions in the Antarctic, and the meteorological observations were thus very important. It was largely due to the courage and tenacity of Gerlache that the party emerged with all its collections in good condition. The large number of antarctic expeditions in the early years of the twentieth century eclipsed to some extent the pioneer work of the *Belgica*; but the imposing array of scientific results produced at the cost of the Belgian Government is an abiding monument.

Gerlache continued to interest himself in polar matters. He commanded the *Belgica* in the Duke of Orlean's scientific expedition to the East Greenland Sea in 1905 and he promoted the building of a fine ice-protected ship designed for sporting cruises about Spitsbergen. The ship was built, and though the project failed, Gerlache had the satisfaction of transferring her to Sir Ernest Shackleton in 1914 and superintended her adaptation as the *Endurance* for the ill-fated expedition to the Weddell Sea.

The slow publication of the *Belgica* results, long suspended by the War, left Gerlache with the last volume of the official narrative practically finished but still unpublished at his death. King Albert created him a Baron in recognition of his great achievements, but Gerlache remained one of the most modest of men and generously allowed his scientific staff all the credit for the work of his expedition.

H. R. M.

Dr. N. E. Brown

NICHOLAS EDWARD BROWN, or "N. E. Br", as he was known to botanists all over the world, died on November 25 at his residence in The Avenue, Kew Gardens, after a few months' illness. This indefatigable taxonomic botanist seemed as keenly interested as ever in his subject at eighty-five years of age, and he was still busy with a monograph of *Conophytum* (a segregate from *Mesembryanthemum*), for which he had prepared a number of beautifully drawn and coloured plates with minute dissections. He was a very good botanical artist, and a skilful microscopist, being a member of the Quekett Club.

Brown was a native of Redhill, and was educated at the Reigate Grammar School. On leaving school he was employed for a few years in the latter town as curator of Mr. Wilson Saunders' Museum of Natural History, whence he migrated to the Kew Herbarium in 1873. There he remained until his retirement in 1914. His work at Kew was mainly concerned with the botany of tropical and South Africa, and he was the acknowledged authority on the flora of the latter country. It was largely through his efforts that the "Flora Capensis" was completed. He was an expert on succulent plants and such difficult families as *Asclepiadaceae*, *Ericaceae*, *Euphorbiaceae*, *Iridaceae*, etc. For many years after his retirement, Brown studied the large genus *Mesembryanthemum*, finding in that assemblage a great number of smaller genera.

Brown had been an associate of the Linnean Society since 1879, and in 1921 was awarded the Captain Scott Memorial Medal by the South African Biological Society in recognition of his work on the South African flora. In 1932, the University of the Witwatersrand, Johannesburg, conferred on him the honorary degree of doctor of science. He was a life-long philatelist.

J. H.

PROF. MIKHAILO HRUSHEVSKY, a prominent Ukrainian historian, died in Moscow on November 26, aged sixty-eight years. He was for many years president of the Ukrainian Scientific Shevchenko Society and editor of many scientific journals in Lwow and Kiev.

News and Views

Presentation to Sir Arthur Evans

ON December 17 Sir Arthur Evans, at a meeting of friends and colleagues held at the Society of Antiquaries, was presented with a portrait bust of himself in marble in recognition of his services to archæology, and in commemoration of the completion, in a fourth and final volume, of his great work on the excavation of the Minoan site of Knossos in Crete. The bust is the work of Mr. David Evans, a former Rome Scholar in sculpture. It represents Sir Arthur in academic robes and wearing the medal of the Society of Antiquaries, of which he was the first recipient. The greatness of Sir Arthur's contribution to the study of prehistoric archæology, more especially in the Mediterranean area, was fully recognised by Lord Rennell, who presided, and Prof. R. M. Dawkins, who recounted the more notable achievements of Sir Arthur's career. Lord Rennell, in making the presentation, referred to his work as the source of much of the recent fervour for archæological research, which is doing so much to reconstruct past history on more solid foundations and to confirm the authenticity of tradition. It is salutary at times to be reminded that in 1900, when Sir Arthur Evans made his first discovery at Knossos, the great bronze age culture of the Mediterranean, which has since been revealed as one of the more salient phases in the progress of man to a higher civilisation, survived only in a haze of tradition.

THE magnitude of the reconstruction which has given reality to that tradition in a wealth of data accumulated by excavations on sites in Crete, of which Knossos is the most important and impressive, was indicated by Prof. Dawkins in his brief correlation of the site at Knossos with those other areas of excavation in Crete which both supplement and help to interpret it. In like sense he also dwelt on the account of Knossos which appears in Sir Arthur's complete study, "The Palace of Knossos". As he pointed out, there will be found in that work not only a full account of the excavation of the site and the facts which have been revealed at each stage of its uncovering, but also a comprehensive and graphic picture of the whole civilisation of the Minoan age as it flourished in other parts of Crete, as well as of its relations with the world outside. On this side of Sir Arthur's work as a prehistorian it is not possible to dwell here in detail, but to many the imaginative insight which has been displayed in linking up the civilisation of Crete with that of other peoples of the Mediterranean and the near East has been a source of constant inspiration. It was, perhaps, as well that Sir Arthur Evans, in returning thanks, should have reminded those who were present that it was this aspect of his studies which had first attracted him from the Celtic art of Britain to the Ægean.

Memorial to the late Prof. T. E. Peet

A PROPOSAL to commemorate the services of the late Prof. T. Eric Peet to Egyptology and prehistoric archæology is put forward in a letter which appears in the *Times* of December 18 over the signatures of Lord Derby, Sir Robert Mond, Prof. R. M. Dawkins, Prof. Alan H. Gardiner and others interested in the studies with which the name of Prof. Peet is associated. His premature death in February last at fifty-one years of age was a grave loss to archæology, and came at a time when he seemed at the point of reaping a well-deserved reward for many years of strenuous work. It is suggested that the memorial should take the form of a Thomas Eric Peet travelling fellowship, open to the graduates of any British university who are studying either the Ancient Egyptian language and Egyptology, or the prehistoric archæology of the Mediterranean and the Near East. The fellowship will be attached to the Institute of Archæology in the University of Liverpool, the university with which Prof. Peet was connected all his life and in which he held the Brunner chair in Egyptology for fourteen years. For this purpose an appeal is made for a minimum capital sum of £1,000, the income from which would admit of an award in every fourth year. Should any further sum be raised, it would be utilised in a more frequent award or in grants in aid to approved students. Not only do Prof. Peet's services to archæological studies, which enhanced the prestige of British scholarship, deserve some form of lasting recognition, but the manner in which it is proposed to commemorate them should secure the support of all who are interested in promoting the study of the early history of civilisation.

Jubilee of Prof. W. R. Williams

ON December 20, the Lenin Academy of Agricultural Science is celebrating the jubilee of the scientific work of Prof. W. R. Williams, of the Timiriaseff Agricultural Academy, Moscow. Prof. Williams has obtained an international reputation by his original views on soil science, and on the part played in the world's history by mankind's maltreatment of the soil. He has attributed the decay of former civilisations to the spread of arable farming which has always accompanied expanding populations, as he believes that only by a system of farming in which the land is frequently returned to grass can the soil's 'crumb structure' be preserved and its fertility maintained. In a paper presented to the second International Soil Congress, he indicated the sociological significance of his ideas in planning the agricultural reconstruction of Russia, and reiterated the need for a balanced system of mixed farming, in which grassland and animal husbandry would play a leading part. Throughout his life he has been an ardent protagonist of the school that believes that the goal of agricultural science is to preserve the fertility of the earth rather than to stimulate it for immediate profit and leave a legacy of exhausted soils to posterity. His strongly expressed views have provoked frequent criticism; but they have succeeded in

focusing attention on what may shortly become one of the most pressing problems confronting agricultural science.

Augustus George Vernon-Harcourt, 1834–1919

ON Christmas Eve occurs the centenary of the birth of Augustus George Vernon-Harcourt, president of the Chemical Society in 1895–97, professor of chemistry in Christ Church College, Oxford, and one of the Metropolitan Gas Referees. The son of Admiral F. E. Vernon-Harcourt and grandson of Edward Harcourt, Archbishop of York, he was a nephew of William Vernon Harcourt (1789–1871), one of the founders of the British Association and brother of Leveson Francis Vernon-Harcourt (1839–1907), who from 1882 until 1905 was professor of civil engineering at University College, London. A. G. Vernon-Harcourt was educated at Cheam and Harrow and entered Balliol College with a scholarship in natural science, and after studying under Sir Benjamin Collins Brodie (1817–80) became his assistant. In 1859 he was made Lee's reader in chemistry and began contributing papers to the *Chemical News* and the Chemical Society. His earliest researches related to oxidation, and from these he passed to others on the rate of chemical change which—in conjunction with those of Berthelot in France and those of Guldberg in Norway—were to establish on a quantitative basis Berthollet's law of mass action. In much of his work he collaborated with William Esson (1838–1916), the Savilian professor of geometry. In the engineering world he was known for his investigations on coal and coal-gas. When he became a Metropolitan Gas Referee, the old sperm candle of the law of 1860 was the legal standard of illumination, but this was eventually replaced by the 10-candle pentane lamp of Vernon-Harcourt. An interesting episode in his later years was the banquet given in 1910 by the Chemical Society to five of its oldest members who had served as president. The five were Sir Henry Roscoe, Dr. Hugo Müller, Sir William Crookes, Prof. William Odling and Prof. Vernon-Harcourt. Of the five, Vernon-Harcourt, who died on April 23, 1919, was the last survivor but one, Odling outliving him a few years.

The New Star in Hercules

EARLY on the morning of December 13, Mr. J. P. M. Prentice, who is a regular meteor observer at Stowmarket, noticed a bright star in an unusual position and telegraphed to the Royal Observatory at Greenwich. The message was received at 5^h, and Mr. Martin promptly secured a spectrum of the nova with the Yapp reflector. The Nova had an apparent magnitude of about 3, and exhibited a typical Nova spectrum with emission lines of hydrogen and helium. By a fortunate chance, a break in the clouds occurred over Greenwich at 12^h 40^m, which enabled Mr. Acton to observe the star's position with the transit circle. Its apparent position at transit at Greenwich on 1934 Dec. 13 was R.A. 18^h 5^m $38{\cdot}3^s$, Dec. $+45°$ $50'$ $52{\cdot}9''$. The star is very close to the present position of the sun in Right Ascension, but its northerly declination makes it an accessible object at twilight. It is plainly visible to the naked eye, situated about 10° north-west of Vega. A photographic plate was exposed on the astrographic telescope at Greenwich on the evening of December 13, which enabled the nova to be identified with a fifteenth magnitude star on the Franklin Adams plates. It has accordingly risen about twelve magnitudes. Further spectra have been secured at Greenwich and at the Solar Physics Observatory, Cambridge. From an examination of the spectrum, the Astronomer Royal, who spoke briefly on the subject at the meeting of the Royal Astronomical Society on December 14, concluded that the star had just passed its maximum brilliancy when discovered. Assuming the absolute magnitude at maximum to be -6, the Nova is about 2,000 light years away. Subsequent developments in apparent magnitude and spectrum are being watched with interest at a number of observatories. So far as has been ascertained, there was no independent discovery of the Nova. Its position was, of course, communicated through the usual channels on December 13.

Earthquakes of December 15

Two destructive earthquakes, one of great strength, were felt in different parts of Asia on December 15. Of the slighter, the time of occurrence is not stated, but it may have been the one recorded at Alipore (Calcutta) at 2.15 a.m. (Indian time) or 8.45 p.m. on December 14 (G.M.T.). From the early reports, it appears that more than twenty persons were killed and about a hundred injured, and that at least 25 villages were destroyed. The shocks were strongest in the neighbourhood of Chapakjur, between Diarbekr and Mush, or about ninety miles south of Erzerum. Both Diarbekr and Mush are close to centres of earthquakes of semi-destructive intensity. The second and stronger earthquake was widely recorded. According to the report issued from the Kew Observatory, the first movements were recorded there at 2 h. 8 m. 31 s. (G.M.T.), the epicentre being at a distance of about 4,500 miles. In the largest oscillations that arrived at 2 h. 34 m., the earth movements at Kew exceeded 0·01 in. These are the largest recorded since July 18, due to an earthquake in the Pacific, but they are less than half those from the Bihar earthquake of last January 15. The seismogram at Bombay shows that the epicentre was about 1,300 miles from that city, from which it would seem that the earthquake occurred in Tibet a few seconds before 1 h. 58 m. (G.M.T.). From such a source we are unlikely to receive direct evidence. In the *International Seismological Summary*, however, we find recorded many earthquakes with their centres in that country, an origin that agrees rather closely with the distances given above, being that of the strong earthquake of October 8, 1924.

Racial Problems in Africa: a Suggestion

MUCH interest has been aroused by a suggestion for dealing with the native problem in East and South Africa, which has been put forward by Col. Carbutt, Chief Native Commissioner for Southern Rhodesia. Writing in the annual publication appearing under

the auspices of the Native Affairs Department, and pointing to the problems which arise from the development side by side of the white and black populations, it seems that he advocates the formation of a dominion in which the interests of the black population would be paramount. Such a dominion, which would permit of the civil and political development to the full of the black population, might, it is suggested, comprise the present territories of Uganda, Tanganyika, Nyasaland and Northern Rhodesia, where white settlement and development have not reached a stage, such as that, for example, in Kenya and Southern Rhodesia, which would prove an insuperable obstacle to this policy. Inevitably, some sacrifice would be involved, but in other areas, in compensation, the interests of the white population would be recognised as paramount. Col. Carbutt stresses the argument, of which indeed the force must be patent to everyone, that a solution of the native problem is vital for the future of the commonwealth of British peoples, and at the same time maintains that such a solution as he suggests would be acceptable to, and indeed welcomed by, the natives themselves. It would appear already to have been received with some measure of approval in Africa, if mainly as representing an advance toward the idea of a federation of the two Rhodesias and Nyasaland, or even of a united East and South Africa.

THE proposal that a dominion should be formed north of the Zambezi constituting what would be, virtually, a vast self-governing reserve for native tribes is an adaptation to conditions in East and South Africa of a proposal put forward some years ago by the late Prof. J. W. Gregory. Prof. Gregory, who was convinced that, on the whole, intimate contact between white and coloured races was harmful to both, thought that the solution of the world's racial problem lay in some such territorial segregation of the white and the coloured races according to their respective adaptation to climatic and other conditions. The black races were to be confined mainly to the tropical belt. The proposal now put forward by Col. Carbutt has the merit that while it might follow as a logical development of the policies of segregation and 'indirect rule', it would afford opportunities for cultural, political and economic development of the native along the lines of his own institutions and without too abrupt a break with tradition, such as will be, it is becoming increasingly obvious, if not impossible, at any rate extremely difficult to secure in present conditions. Clearly the political status of such a dominion would have to be such as to entail a lengthy period of tutelage, pending the attainment by the native of an adequate measure of competence in the conduct of affairs, and to ensure avoidance of difficulties such as have arisen in Liberia.

Science and Armaments

IN an address before the Bristol Section of the Institute of Chemistry on December 10, Dr. Herbert Levinstein asserted that the destructive power of science in war is absurdly overrated, and that the application of chemical science to war has not made war more dangerous either to soldiers or to civilians. He argued further that scientific warfare is more humane and, because its continual inventiveness introduces an element of surprise, is more likely to bring a war to an early conclusion. The great wastage of life in the War of 1914–18 was due to lack of invention, to reliance on mere numbers of men or projectiles and on obsolete tactics. Dr. Levinstein stressed further the close connexion between chemical industry and chemical warfare, asserting that the prohibition of chemical warfare in the Treaty of Versailles was not due to the horrors of such warfare but to disparity in strength between German chemical industry and that of other countries. He regards as unworkable the suggestion that chemists should agree not to produce any substance used for warlike purposes, because differences between warlike and non-warlike substances are too subtle to be effective.

DR. LEVINSTEIN'S address was doubtless provocative by design but to what purpose is obscure. A discussion on the relative humanity of various methods of warfare is as futile and beside the mark as it is unscientific. Moreover, chemical industry at the present time is scarcely so undeveloped in Great Britain as to merit the rather dubious support which its relation to chemical warfare may lend it. A satisfactory and scientific approach to armament, as to disarmament, is that indicated by Major Lefebure in his book "Scientific Disarmament". The piecemeal discussion of this difficult question is always dangerous and Dr. Levinstein's treatment goes far to nullify the value of his warning that the possibility of chemical warfare cannot be excluded merely by treaty provisions. The moral aspects of the participation of the scientific worker in preparation for warfare were rather too lightly dismissed by Dr. Levinstein, whose remarks here were all the more disappointing because of the need for clear thinking and close discussion by scientific men of this important matter. The creation of a definite professional opinion and code may be a slow process, but it should not be dismissed as impossible. On the other hand, there are definite spheres in which the chemist and other scientific workers can render important services in national defence to which no suggestion of extending the area of conflict can be attached. One such proposal is contained in a long article in the *Retail Chemist* for December in which an organisation of all the chemists of the country to deal with the effects of poison gas attack on the civilian population is advocated. The First Aid posts for gas casualties suggested by Major-Gen. P. S. Wilkinson, of the Order of St. John of Jerusalem, is another such practical proposal in which the knowledge and experience of the chemist might be of direct service to the community.

Artificial Nuclear Transmutations

LORD RUTHERFORD, in his Ludwig Mond lecture at the University of Manchester on December 10, described how recent work in the study of artificial nuclear transmutations is giving rise to a new

chemistry, concerned not with the outer layers of the atom but with the nucleus itself. The transmutations of one element into another involves adding or subtracting a particle, charged or uncharged, to or from the nucleus, and this may be effected in many cases by bombardment with foreign particles. A few of these particles may enter the nucleus, and this may sometimes lead to the emission of a particle from the nucleus itself. The first of such transmutations was accomplished in 1919, when nitrogen was disintegrated by α-particle bombardment with the liberation of fast protons. More recently, a new type of disintegration has been discovered in which a neutron is emitted. In these cases the residual nucleus in the transformations is stable. In the cases investigated by M. and Mme. Curie-Joliot, an artificial radioactive element is formed by bombarding a light element with α-particles. Fermi and his collaborators have found that a very large number of elements can be disintegrated by neutron bombardment, giving artificial radioactive elements. The neutron, on account of its lack of charge, can penetrate the heavy nuclei when α-particles would be turned back. Finally, Lord Rutherford directed attention to the accomplished production of nuclear disintegration, using bombarding particles artificially accelerated by high voltages instead of the particles emitted from natural radio-elements.

Science and Road Traffic

IN his lecture before the British Science Guild on December 19, Col. Mervyn O'Gorman discussed the application of science to the problems of road traffic. Road traffic, he said, is not replaceable by other distributive agencies, and its prosperity is indeed advantageous to them. The magnitude of motor transport as an industry is such that it has more employees, involves more capital wealth, and pays larger taxation to the State than almost any other industry in England. Improvement which is being, and must be, sought in safety of distribution by road involves getting the largest amount of road distribution achieved per single accident. The business of evolving the necessary instruments, the analytical methods, the interpretation of data, and similar work on the accident ratio is the proper function of science, especially physics, mechanics, mathematics, chemistry, geology, metallurgy, statistics, physiology, psychology, etc. A committee should be formed to advise and undertake research, and it should not contain road interests (financial or professional) and it should receive all the specific 'road and traffic' information that it needs from the Ministries of Transport and of Health, the Home Office and from witnesses. Following the precedent of the successful Aeronautical Research Committee at its foundation in 1908, it should report direct to the First Lord of the Treasury. Its members should be paid, and should all be scientific men, preferably nominated by the Royal Society in conjunction with the Department of Scientific and Industrial Research. The committee having been formed, it should be free to formulate and verify its own theories in the study of safe traffic flow, economic flow, pedestrian flow, etc., these being the frameworks of various long-range researches.

Maternal Mortality

SIR HILTON YOUNG, the Minister of Health, received on December 11 a deputation from the Maternal Mortality Committee. Mrs. H. J. Tennant, introducing the deputation, said that it represented more than 3,000,000 women and was the outcome of a meeting on the subject of maternal mortality held in November. Mrs. Barton said that malnutrition, though not a primary cause, is a contributing factor to maternal mortality, and she fears that the block grant system of Exchequer grants is less effective in stimulating local authorities than the former percentage grants. Lady Barrett dealt with the question of ante-natal care, and the necessity of improving the training of doctors and midwives. Miss Gregory considers that midwives ought to have a two- or three-year course in a first-class hospital. Other speakers stressed the importance of maternity and child welfare services. The Minister, in reply, said that the problem of maternal mortality is giving him grave concern. The maternity and child welfare services of local authorities are being steadily developed, and he considers that no financial check has been placed upon them by the alteration in the grant system. There is no evidence that there is any close relation between malnutrition and a high maternal mortality rate. Nevertheless, the conditions in depressed areas are such as to give rise to anxiety, and the position is receiving the close attention of the administration. He outlined measures that are being taken to improve maternity and child welfare services throughout Great Britain, and alluded to special inquiries and investigations that are being made in districts where the maternal mortality rate is abnormally high.

Further Tests of the Medium Rudi Schneider

IN the *Proceedings* of the Society for Psychical Research for October is published a further report on the alleged psychic phenomena occurring in the presence of the medium Rudi Schneider. Under the joint authorship of Mr. T. Besterman and Mr. O. Gatty, the paper describes an attempt to look for confirmation of the infra-red phenomena previously reported, and generally to conduct tests by instrumental means. As an example of the kind of methods to be used in experimental work with the so-called physical phenomena, the report seems to be a step in advance, and the results suggest that through such instrumental means a better idea of the nature of the phenomena may be obtained. Generally speaking, the present results were negative. The interruption of the infra-red rays as previously reported by Dr. Osty in Paris and by others in Great Britain received no confirmation, in spite of a series of careful observations; and through the help of of Dr. C. G. Douglas it was ascertained that the medium's breathing, which was considered of sufficient interest to reproduce in a recent series of talks

broadcast by the B.B.C., had nothing supernormal about it, being merely somewhat shallow and quite normal considering the muscular movements made by the medium during the trance. Thus the report as a whole contains no good evidence that Rudi Schneider possesses supernormal powers ; and further controversy concerning the case can therefore be postponed until positive evidence is adduced based upon the kind of instrumental methods outlined in the present report.

National Institute of Industrial Psychology

THE annual report of the National Institute of Industrial Psychology appears in the *Human Factor*, vol. 8, No. 12. The Institute is approaching a critical period in its career, when lack of funds may seriously curtail its research work. The report stresses this fact, and describes the work accomplished along various lines, touching on investigations in factories, warehouses, offices and shops, investigations of the processes of distribution, vocational guidance, research and educational work. A vocational guidance scheme has been launched in Bristol ; and large-scale experiments in Fife, and in Borstal institutions, have been completed this year. Researches into the possibility of simplifying and modifying tests of manual skill, and of devising tests for mathematical and linguistic ability, and the part played by rhythm in manual work are being continued. A study of the use of practical performance tests of intelligence and, on the vocational selection side, the analysis of three occupations, namely secretarial work, nursing and secondary school teaching, have been completed.

Liverpool Geological Society

THE seventy-fifth anniversary of the foundation of the Liverpool Geological Society was marked by a scientific conversazione, under the presidency of Dr. R. G. Wills, held in the Department of Geology, of the University of Liverpool, on December 11. The assembly commenced with the reading of the minutes of the first ordinary meeting of the Society in 1859, after which the Society's Medal was presented to Mr. Emil Montag, Swiss consul in Liverpool, for services rendered to the Society during his twenty-four years' active membership, his editorship, his contributions to British and Swiss geology and his work in providing facilities for study in Switzerland. Prof. H. H. Read, Herdman professor of geology in the University of Liverpool, vice-president of the Society, then delivered a short lecture on earthquakes, followed by a demonstration of the University seismograph. Dr. E. Neaverson lectured on palæontological exhibits, and there was a demonstration of rock-cutting and of new maps. Amongst the exhibits on view at the conversazione was an interesting collection of fossils, new instruments and minerals, the latter including specimens of two new British minerals recently found in Scotland ; chondrodite, found in association with metamorphic limestone, and stichite, found in association with ultra-basic rocks.

THE Liverpool Geological Society, which publishes an annual *Proceedings*, has made many valuable contributions to geological history, and among its most distinguished members in the past were George H. Morton, one of its founders, and author of the "Geology of the Country Around Liverpool" (1863). After the Geological Survey had examined the area, a second edition of Morton's work was issued in 1891. The Rev. H. H. Higgins made valuable discoveries of fossil ferns in the Ravenshead railway cutting near Rainhill in 1870, and H. C. Beasley described the well-known labyrinthodont footprints from Storeton quarries, Cheshire, which G. H. Morton later named *Cheirotherium stortonense*. Despite what may be called a geological and palæontological poverty amongst the rocks of its sandstone area, the Liverpool Geological Society has kept research well to the fore in its history, and its *Proceedings* contain many valuable contributions to geological science.

Apparatus for Photographic Reproduction

THE reproduction of documents, drawings, etc., by photography is, of course, widely practised. It is possible by direct photographic printing to do such work without a camera. With sheets of translucent material of which only one side is used for the design or writing, such a method is capable of furnishing a paper negative which may be used for printing positive copies. The same method may be used for making readable copies which are negatives only in respect of black and white. If, however, the sheets of the original have matter on both sides, this simple method of printing is not possible, and it is necessary to use the method of 'reflex' photographic printing to make a negative, from which positive copies are made by printing through. Reflex printing consists in placing a sheet of the sensitive paper in contact with the matter to be copied, and exposing through the sensitive paper. Differential reflection from the design and its background is sufficient to give a printable image. These methods have long been known and used for the reproduction of copies of the same size as the originals. A very convenient portable apparatus comprising lamps, printing frame and automatic exposure timing device, which we have examined, has now been placed on the market by Messrs. Bornett and Co., Ltd., 7–8 Idol Lane, E.C.3. This apparatus is known as the "Rectophot Rapid Reproducer" and is made in two sizes, the smaller of which will deal with papers $13\frac{1}{2}$ in. $\times$ 10 in. ; the larger with 22 in. $\times$ 15 in.

Synthetic Compound with Vitamin B_2 Activity

As is well known, lactoflavin induces growth in rats fed on a vitamin B_2 free diet. In a lecture at the Kaiser Wilhelm Institute for Medical Research in Heidelberg, Richard Kuhn, who with P. György discovered the biological activity of lactoflavin, reported that he had synthesised a compound with the same properties as lactoflavin. The synthetic substance was prepared by interaction of a suitable derivative of 1-nitro-3, 4-xylol with *l*-arabinamin, with subsequent reduction of the product formed and condensation with alloxan. 0·015 mgm. of this substance prevented hypovitaminosis in rats. This dose is of the same order of magnitude as that required for lactoflavin, whereas the corresponding

synthetic substance without the two methyl groups on the benzene ring was completely inactive in this dose. The synthetic substance combines with the protein of the 'yellow ferment' of Warburg, prepared according to the method of Theorell, yielding a catalytically active compound, thus behaving exactly like lactoflavin. The optical rotation in alkaline solution of the two substances is the same. In order to decide definitely whether the two compounds are identical in every respect, Kuhn intends to prepare compounds containing the ribose and xylose radical, instead of arabinose, for comparison.

Irrigation in India

THE report on "Irrigation in India in 1931–32" (Delhi: Department of Industries and Labour) shows that the total irrigated area in British India in that year fell slightly below thirty million acres, of which more than half was in the Punjab and the Madras Presidency. In the whole area, the figures represent slightly more than 12 per cent of the area sown, rising to 34 per cent in the Punjab and 93 per cent in Sind. Among the largest new irrigation works in progress is the construction of a dam at Mettur on the Cauvery to store flood waters. About half this work was completed by the end of the year. The works in connexion with the new Lloyd barrage at Sukkur in Sind are approaching completion.

Research in Dairying

THE annual report for 1933 of the National Institute for Research in Dairying, University of Reading, contains a summary of the work done during the year in the various departments, and brief abstracts of papers published from the Institute. Reference is made to the death of the first director, Dr. Stenhouse Williams, in whose memory a new library building has been erected. Attention is also directed to the financial stringency from which the Institute is suffering, and which will necessitate the abandonment of valuable work now being conducted in the Physiology Department and the Nutritional Laboratory unless additional funds are forthcoming within the next few months.

Exhibition of Architecture

AN exhibition of an interesting character has recently been opened at the new premises of the Royal Institute of British Architects, 66 Portland Place, London, W.1. Here is to be seen a collection of more than 1,200 large photographs of buildings and many models showing recent developments in architecture throughout the world. It has taken two years to bring together this international collection, which is well displayed and is divided into subjects such as public buildings, hospitals, schools, houses, which enables the visitor to compare the designs of leading architects in different countries side by side in a manner which is seldom possible. The exhibition does not deal with planning or construction, but for those interested in these matters there are a few sets of drawings and particulars showing all the stages through which a project must pass before a building can reach completion; the extent of this detailed work will probably be a surprise to the layman. The exhibition is open to the public without charge from 10 to 6 until January 5.

American Association for the Advancement of Science

THE ninety-fifth meeting of the American Association for the Advancement of Science will be held at Pittsburgh commencing on December 27. On December 31, the retiring president, Dr. Henry Norris Russell, will deliver an address entitled "The Atmospheres of the Planets". Among the general addresses to be delivered are: Prof. E. A. Horton, "*Homo sapiens*, Whence and Whither"; Prof. Arthur B. Lamb, "Crystallogenetic Adsorbents"; Dr. A. Franklin Shull, "Weismann and Hæckel: One Hundred Years"; Prof. H. H. Newman, "Twins reared apart and the Nature-Nurture Problem"; Dr. Mark H. Liddell, "The Auditory Spectrum". Prof. Albert Einstein will deliver the Josiah Willard Gibbs lecture of the American Mathematical Society on December 28. On December 30, there will be a symposium on the relation between science, especially scientific organisations and institutions, and the Press. Speakers will represent the universities, technical and medical schools, the National Association of Science Writers, Science Service, the Associated Press, the Hearst Service and representative newspapers. Further information about the meeting can be obtained from Dr. Henry B. Ward, American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D.C.

Announcements

SIR ISIDORE SALMON, chairman and managing director of Messrs. J. Lyons and Co., Ltd., has been elected president of the Decimal Association, in succession to Lord Hirst.

THE Karl Sudhoff medal has been awarded by the German Society of the History of Medicine, Natural Sciences and Technique to Prof. T. Győry, professor of the history of medicine in the University of Budapest.

THE annual meeting in 1935 of the British Medical Association will be held at Melbourne on September 11–13, under the presidency of Sir Richard Stawell, consulting physician to the Melbourne Hospital.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in electrical engineering at the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Education Office, Town Hall, Hanley, Stoke-on-Trent (Dec. 31). An assistant in the Technological Department of the Royal Scottish Museum, Edinburgh, 1—The Director (Jan. 12). A principal of the Northern Counties' Training College of Cookery and Domestic Science, Newcastle-upon-Tyne—The Secretary (Jan. 14). An assistant in natural history in the University of Aberdeen—The Secretary (Jan. 20). A Dunville professor of physiology and a J. C. White professor of biochemistry in the Queen's University of Belfast—The Secretary (Feb. 28). A chemist in the Admiralty Chemical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1.

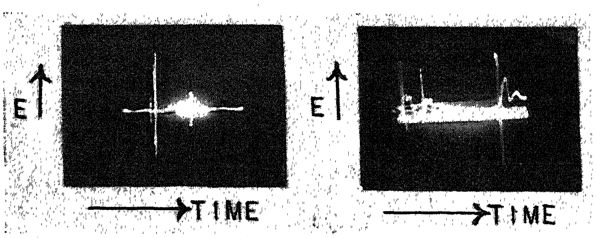
Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 974.

The Lightning Flash as Source of an Atmospheric

DURING the last few years we have made, on the roof of King's College, London, a series of observations on the rapid variations of the earth's electric field associated with thundercloud discharges, using a Wilson sphere as the conductor exposed to the earth's field, and a cathode ray oscillograph, with photographic registration, as the recording instrument[1]. In this way we have been able to follow the evolution of an atmospheric wave-form from the discontinuous change of field associated with near flashes to the type of radiation field, with its high-frequency detail, observed at greater distances. These experiments, together with allied investigations carried out at the Slough Radio Research Station of the National Physical Laboratory, were described at the recent meeting of the International Scientific Radio Union in London (September 1934).



(a) (b)

FIG. 1.

The observations have, however, more than radiotelegraphic interest, for they yield information relating to the nature of a thundercloud discharge. In the older measurements made using the relatively sluggish capillary electrometer, the effect of a net change of field was shown by a single discontinuity on the photographic record. With the string electrometer (as used here by Dr. J. T. Henderson and one of the writers) or cathode ray oscillograph, it is found that, while the most frequent type of discharge is one which takes place in a single 'step', the next most frequent type is one consisting of two or three components. The existence of these component 'steps' obviously indicates that a thundercloud moment is frequently destroyed in a series of partial discharges.

Now if atmospherics originate in lightning flashes, we might expect them to have the same tendency to occur in groups, and this is indeed found to be the case, the order of magnitude of the time intervals between successive components being the same as that observed in the net change observations made on near discharges. Two examples of such grouping are shown in the accompanying records. Fig. 1(*a*) shows a cathode ray oscillographic record of the electric field E during a group of three component disturbances, the wave-forms being unresolved because the time-base stroke is relatively slow (0·1 sec.). Fig. 1(*b*) shows another group of three discharges with a repeating time-base of 0·005 sec. duration. Here the atmospheric wave-forms are delineated and it is seen that the components of the group have very similar wave-forms.

It is obvious that this grouping of the net change 'steps' and atmospheric impulses of similar waveform is to be correlated with the multiple flashes recorded by Walter and others using a moving camera. We may not, perhaps, be able to classify a thundercloud discharge as a relaxation oscillator, but the intermittent type of discharge appears similar to the familiar periodic sparking of a Wimshurst machine, steadily driven, to which a small Leyden jar is connected.

An interesting feature of the multiple flashes (and the resulting multiple atmospherics) is that a relatively big component discharge is very frequently associated with a relatively long succeeding interval, and vice versa; and in the case of many multiple flashes, the interval between any two successive partial discharges is actually proportional to the magnitude of the first partial discharge. The significance of this would appear to be as follows. We must regard the charge pouring into the head of the channel as reaching a certain critical value before a partial discharge takes place. Whatever be the (variable) amount lost in a component discharge, it appears to be replenished at a constant rate until the same critical value is again reached. An analogous effect would be provided, in the Wimshurst machine experiment cited above, by some agency which, when a spark was in progress, quenched it after a short interval of time which varied from spark to spark.

These experiments, like the allied investigations at Slough, have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.
F. W. CHAPMAN.

Wheatstone Laboratory,
King's College,
London.
Nov. 26.

[1] Chapman, NATURE, 131, 620, April 29, 1933.

The Mass of the Neutron

THE mass of the neutron is considered by Chadwick[1] to be above 1·003 and probably to lie between 1·003 and 1·008. He gives the most probable value as determined by bombardment of boron by α-particles as 1·0067. The validity of this value rests on the assumption that γ-rays are not emitted in the process. Curie and Joliot[2] give a much higher (1·012) and Lawrence and others[3] a much lower (1·0002) value.

On the basis of the values of Fig. 1, and the mass data of Aston and Bainbridge, it seems that a probable lower limit of 1·0052 can be set for the mass of the neutron, by the use of a different

reaction from that of Chadwick. The reaction is:

$$\underset{\substack{14{\cdot}008\pm\\0{\cdot}0028}}{\mathrm{N}} + n \rightarrow \underset{\substack{11{\cdot}0110\pm\\0{\cdot}0005}}{\mathrm{B}} + \underset{\substack{4{\cdot}00216\pm\\0{\cdot}0004}}{\mathrm{He}} \quad (1)$$

Fig. 1 indicates that in this reaction kinetic energy is usually lost, due presumably to the emission of γ-rays or to the production of an artificial radioactivity. This energy contributes to the γ-ray and radioactive energy, which may be denoted by $E_{\gamma+r}$ However, five disintegrations have been obtained: one by Feather, one by Meitner and Philipp, and three in this laboratory, in which kinetic energy is *conserved*. If in this case, $E_{\gamma+r}$ has a positive value, the energy represented by it must be produced from the corresponding amount of mass $m_{\gamma+r}$.

On this basis, the minimum mass of the neutron is 1·0052 and its actual mass (m_n) is given by

$$m_n = 1{\cdot}0052 + m_{\gamma+r}.$$

The greatest uncertainty here is due to the large probable error in Aston's determination of the atomic mass of nitrogen.

The mass of the neutron may also be determined by means of the reaction

$$\underset{\substack{9{\cdot}0155\pm\\0{\cdot}0006}}{{}_4\mathrm{Be}_1{}^9} + \underset{\substack{4{\cdot}00216\pm\\0{\cdot}0004}}{{}_2\mathrm{He}_0{}^4} \rightarrow \underset{\substack{12{\cdot}0036\pm\\0{\cdot}0012}}{{}_6\mathrm{C}_0{}^{12}} + n\,(+\gamma) \quad (2)$$

from the velocities of the particles and the angles between their tracks. Since the angles are usually unknown, the mass of the neutron can be found only when its maximum velocity is attained.

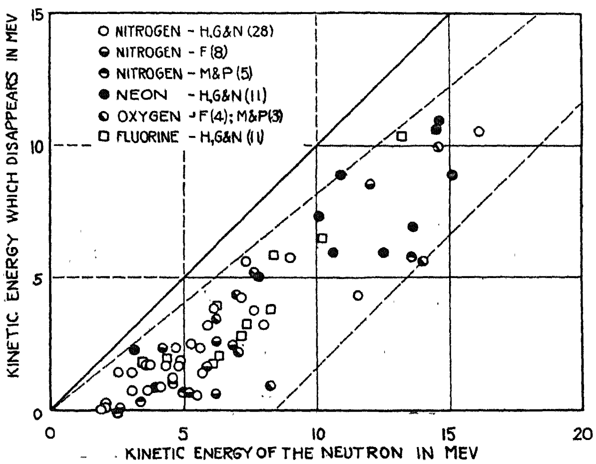


FIG. 1.—The kinetic energy which disappears in a nuclear reaction in which the nucleus specified is disintegrated by capture of a neutron. This energy may be emitted as a γ-ray, or, as has been found of the nitrogen (16) produced from fluorine, the energy takes the form of an induced radioactivity.

The fastest known neutron (energy = 16·1 mev.) produced by a fast α-particle (E = 8·761 mev.) was obtained by Harkins, Gans and Newson from reaction (2). Three other neutrons of energy 15 mev. were obtained by the same reaction. Feather obtained a neutron of 12 mev. energy by the same reaction but by the use of a slower α-particle (5·25 mev.). On account of the fact that the geometry of his apparatus is different from that of the others, the angle θ involved in Feather's work is somewhat doubtful, so his work is not used in obtaining the average value of the mass of the neutron. The calculations are summarised in the accompanying table, in which θ is the angle between the direction of the α-particle and that of the neutron. If the value of θ is greater than that given in the accompanying table, then the true result for the mass of the neutron is less than that given in the table.

Mass of the Neutron as Determined from that of Beryllium by Reaction 2.

Observer	K.E.-particle in mev.	Number of neutrons	Average K.E.-neutron	θ	Mass of neutron
H	8·761	1	16·1	0°	1·0059
H	8·761	3	14·7	0°	1·0073
F	5·253	1	12	90°	1·0052
D	7·683		14·2	0°	1·0068
M	5·253	1	13	0°	1·0053
M	5·253	1	14	0°	1·0042

H = Harkins, Gans and Newson. F = Feather. D = Dunning. M = Meitner and Philipp.

The average of all of the masses, except that of Feather, is $m_{av.}$ = 1·0059, and the average of the two masses obtained by us is 1·0066 as has already been pointed out, but since it is only the maximum kinetic energy of the neutron that should be used, we may put our value of the mass as 1·006.

While the reaction utilised for the determination of the mass of the neutron is different from that used by Chadwick, the basic assumptions involved are the same, namely, that no γ-ray is emitted by the same individual atom which emits the neutron. Also the nucleus which is produced, ${}_6\mathrm{C}_0{}^{12}$, is assumed to be formed in its normal state. If it is in an excited state its mass is greater by m^*.

Thus the mass of the neutron is, as determined by

Chadwick : $1{\cdot}0067 - (m_\gamma + m^*)$
Average of H. and G. : $1{\cdot}0066 - (m_\gamma + m^*)$.

After a consideration of all of the factors involved, and especially since the term $-(m_\gamma + m^*)$ represents a negative value—unless it is zero, which is by no means certain—we suggest that the value 1·006 be used for the neutron until more accurate positive ray work is done, and also the knowledge of the magnitude of this term becomes more definite. This is only very slightly less than the value proposed by Chadwick. It should be recognised that the term $(m_\gamma + m^*)$, if not zero, would have a different magnitude in the reaction used by him from what it has in that used by us. The accuracy of the lower limit for the mass, 1·0052, is set by the accuracy of the positive ray work on which it is based.

WILLIAM D. HARKINS.
DAVID M. GANS.
University of Chicago.
Oct. 23.

[1] Chadwick, J., *Proc. Roy. Soc.*, A, **136**, 702; 1932.
[2] Curie-Joliot, *C.R.*, **197**, 237; 1933.
[3] Lewis, Livingston, Henderson and Lawrence, *Phys. Rev.*, **45**, 497; 1934.

The 1933 Everest Climbing Expedition and Oxygen

IN his book "Everest", Mr. Hugh Ruttledge tells us that the best route to the top, planned out by Norton, is "difficult and dangerous . . . imagine a house-roof covered with loose snow of such consistence that it cannot hold the feet and thus prevent a slip". Work is required "of the most arduous and exacting nature". Mr. Smythe was often knee-deep and even thigh-deep on these ledges, and great climber as he is, gained only 50 ft. in an hour. He says "the difficulty of the mountain, the evil effects

of altitude, the possibility of being benighted, the risks of sudden storms, and the danger of exhaustion, are so serious that oxygen should be taken if it can aid the climber. . . . Prior to 1933 there were those to whom the thought of it was abhorrent, I confess to a similar prejudice".

"There is no doubt that long residence at Camp IV and above allowed deterioration to set in."

One climber on returning to the base camp recorded that his "body was a horrible sight . . . all the ribs sticking out and hardly anything on my arms and legs at all". Three climbers suffered from dilated hearts. The rapid recovery of most of the climbers was very noticeable during the return march.

Before the start of the last Everest climbing expedition, I directed attention to Dr. Argyll Campbell's experiments which showed that animals could not be acclimatised to live for long at altitudes above 18,000 ft. Owing to want of oxygen, deterioration set in, and the animals finally showed degeneration of certain organs, such as the heart and liver. They recovered if exposure to the low concentration of oxygen was terminated before deterioration had advanced too far. Dr. Campbell recently has confirmed his previous results; animals can live in a concentration of oxygen equal to 12 per cent of one atmosphere, but not for more than six weeks in one equal to 10 per cent. I ventured to urge the need for the climbers to use oxygen breathing apparatus.

Dr. Raymond Greene says that, according to the modern theory, acclimatisation takes place in three ways: (1) increase in the number of red cells which carry oxygen in the blood; (2) increase in ventilation of the lungs; (3) possibly by active secreting of oxygen into the blood by the lungs. There is no sure evidence of this last. Dr. Greene lays stress on the fact that deep breathing washes carbon dioxide out, and so lowers the normal acidity of the body, but the kidneys correct this by secreting more alkali. There may be a lag in the kidney effecting this correction. To effect this and develop more red cells and the breathing powers, a slow ascent to the base camp is needed.

Dr. Greene leaves out of account a most important means of acclimatisation, one which has been pointed out by Dr. Campbell, namely, hypertrophy of the heart. We know that a hare has a much larger heart than a rabbit, in order to meet the demands made upon it in the effort of rapid flight. The output of the heart and the volume of blood circulating each minute is made much greater by the athlete developing a large, strong heart. This is what the climbers develop by spending ample time in climbing to the base camp and then to the foot of the North Col. It is recorded that "The local Thibetans exhibit greater energy on the Rangbuk glacier than the still comparatively unacclimatised Sherpa porters". We may be sure that these Thibetans must, for their size, like a hare, possess large and powerful hearts. The heart, the blood, the breathing muscles, are all developed by slow acclimatisation, while the nervous system becomes accustomed to enduring the want of oxygen at high altitudes.

During the time spent above 18,000 ft., the limit of possible acclimatisation for prolonged exposure, the vital organs, heart and brain, are maintained at the expense of the other parts of the body, hence the signs of deterioration and wasting.

Experienced Himalayan climbers have the advantage of hearts already developed by previous expeditions. They can climb above the North Col and reach 28,000 ft. and spend even three nights as Mr. Smythe did at 27,400 ft. in a tent carried there by the porters, but even they climb with difficulty, owing to shortage of oxygen. Mr. Smythe reports what apparently were hallucinations. He saw things in the sky and thought he was accompanied when he was alone. He was quite unable to face, above 28,000 ft., a piece of rock climbing which he says he would have tackled under ordinary Alpine conditions. All the time the climbers are deteriorating, and it is a question whether any climber will have a heart stout enough to take him to the top even under the most favourable conditions of weather and snow.

The use of oxygen breathing apparatus is now admitted to be wise for the last and very difficult part of the climb, and for helping the porters to carry material up to the higher camps. It is noteworthy that the breathing of oxygen during the night entirely cured a porter of bad frost-bite, after he had returned from Camp VI to the North Col camp. Two other porters who were much less affected, and therefore were not given oxygen, each lost digits.

LEONARD HILL.

Experiments on the Fermi Effect

WE have studied the intensity of the Fermi effect obtained under identical geometrical conditions, when screens of different materials are interposed between the beryllium-radon source and the substance in which the Fermi effect is excited.

The absorbing blocks were: a semicylinder of gold of 50 mm. length and 26 mm. radius and a similar semicylinder of lead of 23 mm. radius, both with grooves along the axis for the source. The investigated substances were exposed in the form of nearly semicylindrical sheets which after exposure were bent into a nearly cylindrical form with the Geiger counter in their axis. The counter was 50 mm. long with a diameter of 22 mm. and had walls of aluminium 0·2 mm. thick.

The results are collected in the table below, in which, for each substance and absorbers, we give: (*a*) the number of counts in a given time when no absorber was present, (*b*) the number of counts with the absorber present, (*c*) the percentage diminution (−) or increase (+) of the effect.

Table 1.

Substance	Absorber					
	Pb − 19 mm			Au − 22·5 mm		
	a	*b*	*c* Per cent	*a*	*b*	*c* Per cent
Silicon	4002	3370	−16	4290	3140	−27
Aluminium	4260	3412	−20	2881	1984	−31
Silver	1128	1170	+ 4	2360	2875	+22
Iodine				1756	2056	+17

The experiments show a marked difference in behaviour of light and heavy substances. In the last case the effect is increased when the absorber is interposed, which shows that the exciting rays undergo some transformation in the absorbing matter. We put forward the following hypothesis. The capture of a neutron by a heavy nucleus without emission of a heavy particle can take place only when the energy of the neutron does not exceed a

certain value. If the energy of the neutron is too high the neutron loses in a nuclear encounter a part of its energy, which is emitted in the form of a γ radiation.

From this point of view the increase of the Fermi effect would be due to the production of slow neutrons in a number more than compensating for the loss of primary slow neutrons due to absorption. That the slow neutrons are active in producing the Fermi effect in heavy elements is made plausible by the experiments of Meitner[1], who used the probably slow neutrons excited in beryllium by the γ-rays of radium.

The block of gold weighing 963 grams was kindly prepared for us by the Polish State Mint and the gold was lent by the Bank of Poland.

Experiments are being continued.

M. DANYSZ.
J. ROTBLAT.
L. WERTENSTEIN.
M. ŻYW.

Mirosław Kernbaum
Radiological Laboratory,
Society of Sciences,
Warsaw, Poland.
Dec. 1.

[1] *Naturwissenschaften*, 22, 759, Nov. 9, 1934.

Use of Phosphomolybdic Acid in Chemical Analysis

DURING some recent investigations into the structure of the salts of the 12-heteropoly acids, and, in particular, those of 12-phosphomolybdic acid, it was found that the salts of certain monovalent elements were sparingly soluble. This led us to test whether this fact could be made use of in chemical analysis.

It was found that, using phosphomolybdic acid, a solution containing 1 part of cæsium in approximately 500,000 of water could be detected—a far more sensitive test than that of chloro-platinic acid. With potassium, using a concentrated solution of phosphomolybdic acid, a definite precipitate was formed in an acid solution containing 1 part of potassium in 10,000 of water. With such dilute solutions it should be noted that the precipitate takes a few minutes to form. This test is distinctly more sensitive than that of the cobaltinitrite.

Phosphomolybdic acid should be very useful in analytical chemistry, especially in view of the fact that sodium phosphomolybdate and the salts of the di- and trivalent elements are all soluble. The only other insoluble salts of the acid are the ammonium, rubidium, silver, thallous and mercurous salts.

Further tests are now being carried out by one of us (J. W. I.) with a view to the quantitative estimation of potassium with phosphomolybdic acid. The precipitate obtained consists of potassium phosphomolybdate, $K_3PMo_{12}O_{40}.nH_2O$. The water content has not yet been definitely ascertained, but we have reason to believe that it is not greater than $2H_2O$ and probably zero. The structure is closely related to that of $H_3PW_{12}O_{40}.5H_2O$ recently determined by Keggin[1].

The precipitate is very stable, and X-ray powder photographs show that its constitution is unchanged after heating for several hours at 120° C., whereas potassium cobaltinitrite decomposes on heating.

J. W. ILLINGWORTH.
J. A. SANTOS.

Physical Laboratories,
The University,
Manchester.
Nov. 2.

[1] *Proc. Roy. Soc.*, A, **144**, 75; 1934.

Oxygen Preparation from Sodium Peroxide

THE account in NATURE of November 17, p. 778, by Dr. Newton Friend and Mr. S. Marks of an explosion which occurred during the preparation of oxygen from sodium peroxide and water interested us particularly, since in 1924 we had a similar experience. The oxygen was being prepared by dropping water on to solid sodium peroxide in a flask, without heating, and was being led through drying tubes to an ozoniser. The water contained a little cobalt chloride to catalyse the decomposition of the peroxide.

The reaction proceeded quietly for some time, producing a steady stream of oxygen; then suddenly, without any apparent change in the conditions, an extremely violent explosion occurred in the flask, with results similar to those described by Messrs. Newton Friend and Marks. The conditions differed from theirs in that the explosion occurred spontaneously without the introduction of a glowing splint: the ozoniser was undamaged, and it is therefore not very likely that the explosion was initiated by the discharge. We attributed the explosion to the presence of free sodium in the peroxide, and have since avoided this method of preparation as dangerous.

G. H. CHEESMAN.
D. R. DUNCAN.

9, Compton Road,
London, S.W.19.
Nov. 22.

Chemical Linkage

IN the Research Items in NATURE of October 20, certain arguments are advanced in opposition to the views which we expressed in a recent paper published in the *Journal of the Chemical Society*, and without going into detail we wish to take the opportunity of pointing out that: (1) We cannot call to mind any evidence, chemical or physical, for the alleged non-equivalence of the oxygen atoms of the nitro group; the introduction of the 'resonance' linkage is a hypothesis which, in order to maintain a difference of linkage, renders its experimental detection impossible. (2) The existence of two electrons with *parallel* spin in the ground level of the oxygen molecule is definitely established by spectroscopic evidence. (3) X-ray spectra reveal the geometrical arrangements of atoms or ions in the crystal lattice and it is true that it is possible to draw definite conclusions with regard to the physical forces present in simple cases. This is, however, by no means possible in complex cases. Thus KIO_3, $CaSnO_3$ and the double salt KF, MgF_2 all possess exactly the same arrangement in the crystal lattice. Similarly, the complex salt $[Co(NH_3)_6]Cl_2$, which possesses a characteristic absorption spectrum, has the same lattice as $[Ni(NH_3)_6]Cl_2$, which fails to give a Raman line for a nickel-NH_3 linkage, and as $(NH_4)_2SiF_6$, which sometimes crystallises with one or more additional molecules of ammonium fluoride.

R. F. HUNTER.
R. SAMUEL.

Department of Chemistry,
Muslim University,
Aligarh.

I AM still not convinced that the equivalence of the two oxygens in the nitro group is "established" by the zero dipole moment of p-dinitrobenzene, nor does the existence of two electrons with parallel spin

in the ground level of the oxygen molecule prove that the molecule is unsymmetrical. It is also true that the "generally accepted deductions" from crystallographic evidence are in favour of the existence of the complex cations $[Co.6NH_3]^{+++}$ and $[Ni.6NH_3]^{++}$ as well as of the complex anion $[SiF_6]^{--}$. It is perhaps desirable to add that, since the note was written, my doubt whether the theoretical views of the authors of the paper would 'hold water' when subjected to a critical examination has been confirmed by consultation with theoretical physicists, who concur in the view that the chemical deductions are based upon an inexact interpretation of current physical theories.

THE WRITER OF THE NOTE.

Power in Social Psychology

I DO not know how far the columns of NATURE are suitable for the discussion of "power" (in the human community). But when I find no less than three of the nine chief reviews in the issue for December 8 dealing with this question, and Dr. Snow and myself being scolded for "false methodology" and the want of a "robust" political faith, it is perhaps permissible to point out that the class-war dogma which underlies this sort of criticism has no scientific standing.

Social psychology, like every other branch of human ecology, is still in the squinting, vaguely exploratory stage of infancy; we have no adequate description of social "power", no analysis of its miscellany of factors and no clear conception of its attainment or the scope of its operation. We have clear definitions of legal "powers", but these definitions are independent of any qualifications by disregard, resistance or inaccurate or insufficient enforcement. This belatedness of social psychology is a misfortune for the world but it is a fact. That "robust" political faith to which the reviewer urges Dr. Snow, is really emotional doctrinaire mysticism born of impatience and trying to compensate for its poverty of assembled knowledge by a tawdry 'dialectic'.

The premeditated achievement of social resultants is a business for clearer heads and a stouter patience. Formal education, adult education, social stimulation, the mechanisms of production and distribution, a complex of diverse forces, all come into that process. Politicians and rulers of men have to 'get results', but as Dr. Snow's recent novel demonstrates admirably, it is a primary crime against science for a man of science to produce 'results' unjustifiably.

So far as I am concerned, I am not a propagandist but an experimentalist in projection. This class-war stuff, this 'dialectic materialism' is essentially unscientific talk, pseudo-scientific talk; it is literary, pretentious, rhetorical. As sincere, patient and steadfast scientific analysis spreads into human biology we shall begin to get the general concepts of human relationship and social process clear and plain—and then we shall not need to worry about "power"; power will flow to the effective centres of direction. Stalin in our recent conversation accused me of believing in the goodness of human nature. I do at any rate believe in man's ultimate sanity. The political and social imaginations of very many people nowadays seem to me to be obsessed by the transitory triumphs of violence in various countries, and a lot of this talk about the need to organise the illegal seizure of power for direct creative (revolutionary) ends by those masses of the population which presumably have the most unsatisfied desires, is due largely to a lack of perspective in the outlook of the intelligentsia and a want of patience and lucidity in their minds. There is a limit to the concentration of power in human society, beyond which it becomes ineffective and undesirable. The limit has been passed in Germany and Russia to-day.

H. G. WELLS.

I CANNOT answer for the implications Mr. Wells has drawn from the other reviewers. For myself, I am amazed that he does not see himself as a propagandist among his other rôles. Others do; and that is good enough for scientific purposes. Talk of the *seizure* of power in present-day England is, of course, just rubbish. That question has not been raised. What was being discussed was, 'From which fulcrum would the lever for change to the Wellsian World State be finally applied?' Mr. Wells seems to see it in the people in key positions, but paradoxically enough he complains that they have not the brains to see. What then? My contention was that it is not simply an intellectual "seeing" that he must seek but an active desire, a liking for his world solution.

Mr. Wells has left out the emotional content in assent to a social solution. His letter repeats it in simply demanding more scientific examination, as if objective science covered the whole of life, and yet he bases his case on two scientifically unverifiable assertions:

(1) He believes in man's ultimate sanity, meaning, I suppose, that he *feels* people in key positions will ultimately accept his solution.

(2) Power will flow to the effective centres of direction, meaning that he *feels* this will be so although he does not see it happening to-day in Russia and Germany.

I do not see why he should expect others to share his sanguine feelings. H. LEVY.

Relationship of Soils to Manganese Deficiency of Plants

MANGANESE deficiency disease is confined to soils of pH 6·7 or more and occurs especially on heavily limed sandy podsols. Most neutral and alkaline soils, however, evidently contain ample quantities of manganese in a form available to plants. A method of chemical analysis has been found which appears to measure the amount of this available manganese.

(1) The soil is first leached with normal ammonium acetate of pH 7·0. This removes the manganese which can take part in the base-exchange reaction at such a high pH. The amount of this manganese is very small for all alkaline soils, and is well below one part per million of soil for the very fertile calcareous grey soils of the Wimmera districts (Victoria), on which no symptom of deficiency has ever been seen.

(2) The residual soil is then leached in the cold with the same reagent containing 0·2 per cent quinol in solution. (Each leaching is completed in about seven hours.) This second treatment dissolves only those manganic compounds which can oxidise quinol at pH 7 with reasonable speed.

This 'active MnO_2' (using a conventional formula to represent manganic oxides) exceeds 100 parts of manganese per million of soil in the healthy soils tested, and is less than 15 parts in soil associated with manganese deficiency. This is the only test

of many tried which shows a clear difference between healthy and 'deficient' soils.

It seems to follow that manganese is absorbed by the root without first passing into the soil solution as the ion Mn^{++}; the absorption might be either direct as colloidal MnO_2, or by reduction of MnO_2 at the root-soil interface—a reduction which becomes steadily more difficult as the *p*H rises, until only very active MnO_2 can take part in the reaction.

This same test may be expected to show whether it is dangerous to lime on acid soil; trouble may follow if the total manganese dissolved by ammonium acetate and quinol at *p*H 7 does not exceed about 15 parts per million of soil. This suggestion cannot be tested here at present, since manganese deficiency following overliming has as yet been proved on only one Australian soil, itself abnormal. It is thought also that light may be thrown on the state of manganese in the soil horizons by leaching with buffer solutions (such as ammonium acetate) of varying *p*H values, with or without the addition of reducing agents (such as quinol) capable of bringing about definite *r*H values. The details of the work will appear in the *Proceedings* of the Royal Society of Victoria.

G. W. LEEPER.

School of Agriculture,
University,
Melbourne, N.3.
Oct. 18.

Publication of *Nomina Nuda*

DR. VAN DER HORST's communication in NATURE of December 1, p. 852, is of much interest in giving exact information with regard to the conformation of the burrow of an Enteropneust—a subject about which little is known. Without wishing to detract in any way from the value of his note, I find it necessary to criticise one part of it. It is well known to workers in systematic zoology that great inconvenience is caused by the publication of *nomina nuda* or names which are unaccompanied by diagnoses of the new species to which they refer. The binomial designation given to the new species of which a description is to be published later by one of Dr. van der Horst's students is presumably of this character. It may indeed prove to be the case that the form of the burrow is by itself distinctive of the new species; and it might perhaps be argued that since this had been described and figured the name is valid. There are probably few zoologists, however, who would recognise a species of which the type-specimen was a mass of sand and mud containing no part of the animal itself except some of its slime.

The trouble given to taxonomists by introductions of this kind is very real. It is often necessary to waste time and print by explaining why the date of the first mention of a name cannot be accepted as the valid date. Many instances are known in which the *nomen nudum* has not been reprinted, but it remains to encumber the literature. The most troublesome cases, however, are probably those in which controversy is possible on the question whether a name is a *nomen nudum* or not. I feel confident that the great majority of systematists would agree with me in requesting the editor of NATURE to delete all such names from future communications sent for publication in his pages.

SIDNEY F. HARMER.

Melbourn, Cambs.
Dec. 1.

Design of Theodolite Axes

IN NATURE of September 15 a letter from Prof. A. F. C. Pollard points out that the cylindrical bearings adopted for the vertical axis of the Wild precision theodolite leads to a systematic error of the "order of two to four seconds" in the horizontal angles. We, in Egypt, have not had much experience with theodolites of the Wild design, but we have found that the substitution of cylindrical for the old Y-bearings for the telescope (trunnion) axis of English theodolites has not been found to be an improvement but very much the reverse. Whilst the instrument is new, the errors arising from this fault in design do not obtrude themselves, but as soon as the bearings become worn or one of the standards gets slightly bent, the telescope comes to rest in a different position every time it is raised or lowered in elevation. The error arising from this defect is of an 'accidental' nature and may, in an extreme case, amount to one minute.

Another defect in modern English design adopted by some firms is the tightening arrangement for taking up wear in the levelling screws. The old-fashioned method of making a vertical radial cut along the centre of the trivet arm and placing a binding screw at its outer end was perfectly satisfactory and should never have been given up. The modern designs either do not work at all or they grip the screw at one point only instead of along the whole length of the thread.

In addition to these defects, we have had trouble owing to the poor optical qualities of the modern telescopes. Distant points which are easily sighted with an old-fashioned theodolite are invisible in a modern telescope. This is probably due to the adoption of the internal focusing arrangement. The introduction of an additional lens (or lenses) in the optical system cuts out light and impairs the definition.

Speaking generally, the so-called 'dust-proof' covers are a continual source of trouble. We have never found one which keeps out the dust. Also they make the theodolite much more difficult to keep in good order.

Leaving out of account modern instruments of the Wild type, the old Troughton and Simms six-inch theodolite of thirty years ago was the nearest approach to a perfect instrument for field triangulation that has yet been made. We have not found any modification in the design of this type of instrument which has not been found by experience to be a change for the worse.

F. S. RICHARDS.

Survey of Egypt,
El-Giza.

MR. F. S. RICHARDS's letter is an interesting corroboration of the points raised in my original communication and it is hoped that theodolite manufacturers will give the criticisms of Rannie and Dennis, as well as those of Richards, the attention they deserve.

Mr. Richards's remarks about levelling screws are important. In the paper by Rannie and Dennis, to which I have given the reference, it is recorded that badly designed levelling screws were a source of error in the readings of the instrument. In their case, changing the positions of the levelling screws and clamping them strained the alidade axis. Mr. Richards complains that in modern designs the screw-spindle of the levelling screw is imperfectly clamped.

These imperfections can be completely and readily

eliminated by correct design. I have described the correct design of the tapped seating for screw-spindles on p. 52 of my monograph on "The Kinematical Design of Couplings in Instrument Mechanisms" (Adam Hilger, Ltd.) and also in the Thomas Hawksley Lecture[1] for 1933. In the latter will also be found a description of the correct design for the seatings of the ends of the levelling screws for a theodolite, which is just as important as the correct design for the seating of the screw-spindle if strains are to be reduced to a minimum.

A. F. C. POLLARD.

Imperial College of Science and Technology,
South Kensington.
Nov. 29.

[1] *Proc. Inst. Mech. Eng.*, **125**, 154 and 177; 1933.

The New Star in Hercules

THE discovery of this star in the early morning of December 13 by Mr. J. P. M. Prentice at Stowmarket was kindly reported to the Solar Physics Observatory at Cambridge by the Astronomer Royal later in the same morning. Watch has been kept the whole of each night since, the star being circumpolar, and spectra were obtained with the Newall telescope in the early mornings of December 14 and 15. The spectrum is of the usual Nova type, just after maximum brightness, consisting of bright bands of hydrogen and of ionised metals with absorption borders on the side of shorter wave-length. The unusual features on this occasion are the outstanding strength of the displaced absorption lines due to Mg II at 4481 and the fact that the velocity of approach given by the hydrogen and other absorption lines has shown a decrease from about 500 km./sec. to about 250 km./sec. between December 14 and 15. This decrease of the velocity of the first outburst was shown by Nova Geminorum 1912, but it is not a usual feature in Novæ.

F. J. M. STRATTON.

Solar Physics Observatory,
Cambridge.

Red 'Water-Bloom' in Iceland Seas

COMMENTING on Mr. John Hart's note[1] on blood-red water-bloom caused by a ciliate in South African Seas, I may refer to a description of exactly the same thing caused by apparently the same organism, but in Iceland waters, published in *Meddelelser* from the Danish Kommissionen for Havundersögelser (Ser. Plankton 1, No. 8, p. 27; 1909). Hence this phenomenon seems to be, if of short duration, widely distributed, and has previously been recorded.

OVE PAULSEN.

Plankton Laboratory,
Hellerup, Denmark.
Oct. 10.

[1] NATURE, **134**, 459, Sept. 22, 1934.

Points from Foregoing Letters

LIGHTNING may take place either in a single discharge or step-wise, according to evidence obtained with the string galvanometer and the cathode ray oscillograph. Study of the atmospherics which originate in lightning flashes has led Prof. E. V. Appleton and Mr. F. W. Chapman to the view that, when intermittent, lightning is similar to the discharge from a Wimshurst machine to which a small Leyden jar condenser is connected, the frequency between successive discharges being often proportional to the magnitude of the first spark. It seems as though the electrical energy used during the first lightning stroke is being replenished at a constant rate, until a critical value is reached.

A knowledge of the mass of the neutron is important in calculating the energy involved in atomic transmutations. Prof. W. D. Harkins and Dr. D. M. Gans obtain as the most probable value for this constant, 1·006 (oxygen = 16).

The radioactivity induced in silver and iodine by bombardment with neutrons (obtained from a beryllium-radon source) is greater if the neutrons are first passed through a thick barrier of gold or lead; the opposite is true of the radioactivity induced in the lighter elements, silicon and aluminium. This result, obtained by a group of Polish investigators, leads them to the view that the capture of a neutron by a heavy nucleus without the emission of any heavy particle (Fermi effect) can take place only when the energy of the neutron does not exceed a certain value.

Phosphomolybdic acid will detect two parts of cæsium in a million of water, and will precipitate one part of potassium in ten thousand parts of water; it is therefore more sensitive than the cobaltinitrite test, according to Mr. J. W. Illingworth and Mr. J. A. Santos.

Chemical combination, according to Prof. R. F. Hunter and Prof. R. Samuel, consists always of the coupling of atoms by means of the entry into the same group in the molecule of two electrons possessing opposite (antiparallel) spin. They disagree with the views that a single electron can act as a bond, and that two electrons coming from one of the atoms only can act as a link, as envisaged by Sidgwick in the case of one of the oxygens in the nitro group ($-NO_2$), and they claim that all evidence points to the two oxygen atoms in the nitro group being linked in identical manner. Their views were criticised in a Research Item, the writer of which now states that he believes their theoretical conceptions to be unsound.

Manganese, in small quantities, is essential to plants. Mr. G. W. Leeper describes a method of determining the available manganese in soils, and suggests a mechanism for its absorption by plants. He finds more than 100 parts of this element per million in 'healthy' soils; less than 15 parts per million leads to manganese deficiency diseases. This condition is likely to occur in alkaline soils (*p*H 6·7), particularly in podsols, and it is inadvisable to render such soils more alkaline by the addition of lime.

Mr. F. S. Richards directs attention to several imperfections in the design of the axes of theodolites used in survey work, and also in the optical qualities of the telescopes. Prof. Pollard expresses the hope that theodolite manufacturers will take note of the various suggestions which are being made.

Research Items

Uganda and Zimbabwe. The existence of ancient earthworks in Northern Buddu, Uganda, known to the natives as *Biggo bya Muzenyi* ("The Stranger's Forts"), was reported so long ago as 1909 in the *Uganda Official Gazette*, and a report on the "ancient trenches", with plans, was made by A. D. Combe, field geologist, in 1922, but is unpublished. Mr. E. J. Wayland now contributes some notes on these earthworks and other adjacent remains to the *Uganda Journal*, 3, No. 1, accompanied by Mr. Combe's plans, which are published for the first time. The fortifications, as originally described, consisted of an outer rampart and ditch extending for more than 2¼ miles, with flanks resting on the Katonga River, and interior works on a low hill in the centre of the position. The ramparts, much weathered, were still 3–6 ft. in height and the ditch 4 ft. deep. In the centre are two artificial mounds 10–12 ft. high. Small outlying forts exist some six and four miles respectively to west and east. The usual Baganda tradition attributes the origin of these works to a stranger who entered Uganda from the north. Fragments of circular pottery dishes about 4 ft. in diameter were found by Mr. Combe. At Ntusi, 7½ miles south-west from Biggo, traces of apparently irrigation works and middens were examined, and pottery was found here which did not resemble anything now made in Uganda. Although a pottery pipe belonging to a native blacksmith's forge was found, there was no trace of metal. Other traces of occupation are pit-dwellings and shafts of unknown purpose. These works have been attributed to immigrants from Abyssinia who passed on to build Zimbabwe; but this is improbable. There is, however, a strong probability that, though less ancient, they are a more primitive form of the Zimbabwe structures, and like them of Bantu cultural origin.

Algerian Stone Age. The site of a rock-shelter in the neighbourhood of Oran, Algeria, has been investigated by M. Paul Pallary, in a series of excavations, which began in 1928 in response to a suggestion made by M. Boule in the previous year. A detailed account of the site has now appeared (*Mem.* 12, *Inst. de Paléontologie humaine*). The sides of the ravine in which the shelter was situated have long been known to have been honeycombed with habitations of prehistoric man, and the site of the Abri Alain, as M. Pallary has named it, was visited by him in 1906, when he obtained examples of a microlithic industry. The shelter itself has now disappeared, owing to quarrying operations, but the remains of the deposits lie on the site. Fortunately, one portion of the floor was found to have been left undisturbed. This showed four distinct levels under a sealing of calcareous deposit. Of the four levels the two lower are of a yellow colour, above them is a layer of black earth and above that one of chocolate-brown. The black earth level contains a very large number of crushed shells, whereas in the lower levels shells are rare and intact. The characteristic microlithic industry of the site, however, shows little to differentiate the yellow from the black strata, except possibly a slight difference in refinement of workmanship. M. Pallary considers that the results of the excavation support his view, in which he is opposed to his archæological colleagues, that certain pedunculate implements, usually classed as Mousterian, are late and must be regarded as neolithic. This view, it is held, follows from the fact that such implements are, as a rule, found on the surface of shell-heaps. M. Pallary appends a bird's eye view of the stone age cultural succession in North Africa, in which the primitive hand-axe and Acheulean culture are regarded as comparable to the European industries, while 'Aterian' for a localised Mousterian is rejected, and *inter alia*, the term 'Ibéro-Maurusian' is regarded as preferable to 'Capsian' on the ground of priority and conformity to the practice of scientific nomenclature.

Nematodes of the Belgian Coast. "The Free-Living Nemas of the Belgian Coast (2). With General Remarks on the Structure and System of Nemas", by L. A. de Coninck and J. H. Schuurmans Stekhoven, Jr. (*Mém. Mus. R. d'His. Nat. de Belgique*, No. 58, Dec. 1933), is a continuation of the first monograph by the latter author and Adam, in the same publication (No. 49, 1931). Extensive collections were made of mud and sand in the environment of the Canal of Zeebrugge, between Heyst and Zeebrugge, in and around the harbour of Ostend and in the Zwyn. Ten different habitats were investigated, the samples sieved through fine gauze of varied sized mesh and all the nemas counted. Interesting results were obtained, certain forms predominating in certain habitats. It was found that where Chromadoridæ prevailed an *Enteromorpha* species was abundant, the Monhysteridæ liked sandy and shelly districts, whilst the abundant *Bathylaimus assimilis* was found among decaying leaves of *Statice limonium* growing in the sand in a shallow channel filled with brackish water. The discussions on the relationships of the genera and families are very helpful, for the group is an exceeding difficult one. The larvæ and young forms often differ considerably from the adults, and great care must be taken to distinguish them. 2,408 individuals were studied, consisting of 63 species belonging to 39 genera. Several of the species are new to science, and many new to the Belgian fauna.

The Genus *Mallomonas*. Dr. W. Conrad, in his work "Revision du Genre *Mallomonas* Perty (1851) incl. *Pseudomallomonas* Chodat (1920)" (*Mém. Mus. R. d'His. Nat. de Belgique*, No. 56. Brussels, 1933), adds much to his former monograph on the same subject, published in 1927 (*Arch. Protist.*, 59). He now abolishes altogether Chodat's genus *Pseudomallomonas*, the members of which merge naturally into *Mallomonas*, and attaches great importance to the scales which ornament the cell in the different species. Setiform appendages, present in many forms, although distinctive, have in his opinion only a relative value, for they vary in the same species and are easily lost on fixation. *Mallomonas* is an interesting genus with several peculiar features. Besides the curious armature of scales, conical, triangular, quadrilateral, elliptical, discoidal or circular, which are arranged in various ways round the cell and vary little, there may be darts or needles of peculiar shapes, and one or two chromatophores may be present, or these last are sometimes so reduced as to be scarcely perceptible. The shape of the cell is circular, oval or elongated with a long flagellum and sometimes a collar, and the cysts formed inside the cells are very characteristic.

New Echinoderms from Puerto Rico. Austin H. Clark, in two papers, "A New Genus of Brittlestars from Puerto Rico" and "A New Starfish from Puerto Rico" (*Smithsonian Misc. Coll.*, 91, Nos. 13 and 14. Johnson Fund. "Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep". Pubs. 3248 and 3249, May 1934), describes some interesting new starfishes. One of these is a curious Ophiuran representing a new genus of the family Hemieuryalidæ. *Quironia johnsoni*, n.gen. et sp., resembles *Sigsbeia* but with certain distinctive features. The family as at present understood includes ten genera, of which six occur in the West Indies. Of these six West Indian genera, four are known only from the Caribbean region, one is found also in other parts of the tropical Atlantic and one is represented also in the Galapagos Islands. In the second paper a new species of *Odinia* is described. This is specially interesting as the family to which it belongs, although well represented on the Atlantic coasts of Africa and of Europe, is known from the Caribbean region only from the single somewhat problematic genus *Hymeno discus*, which was described from a single species represented by two evidently young individuals.

Resistance to Cutting of Vegetable Tissues. Henri Prat has recently described an ingenious apparatus for determining the force required to drive a safety razor blade through the tissues of a plant, under conditions which are standardised in application (*Canad. J. Res.*, 11, No. 4). The method is open to criticism in points of detail, but the differences in the behaviour of different regions of the same grass internode are obviously far too great to be masked by any of the experimental errors associated with the method. In these preliminary observations the new method has probably told the author nothing that is not readily deduced from the known developmental history of the grass shoot, but any attempt to introduce new numerical data in the comparison of biological qualities deserves sympathetic consideration.

Effect of Cane Molasses on Swamp Soil. Further investigations on the rôle of organic matter in plant nutrition are discussed by T. R. Bhaskaran and others (*Proc. Ind. Acad. Sci.*, 1, No. 4, 155). A solution of molasses, an abundant by-product of the sugar industry consisting of easily fermentable sugars with a small percentage of minerals and nitrogen, was added to soil samples, and the whole submerged by addition of water. The supernatant solution was then analysed at intervals for several weeks. The sugars are mostly decomposed a few days after addition, forming lactic, acetic, propionic and butyric acids, minute quantities of ethyl alcohol, acetaldehyde and fusel oil. The gaseous products consist of abundant carbon dioxide with small amounts of hydrogen, methane and other hydrocarbons, arising presumably from bacterial action. Most of the carbon dioxide produced is lost from the soil system. The acid products of fermentation bring about the solution of increasing quantities of minerals, which, however, are reprecipitated after about a month, when the concentration in the solution resumes its original value. The concentrations of iron and aluminium early assume toxic values, but decline later to the initial level. Dissolved iron is present in the ferrous condition, perhaps in association with organic acids. The solubility of phosphorus is not affected, but considerable amounts of potassium and calcium dissolve and remain in solution for two months. The treatment with molasses causes a temporary increase in the bacterial content of the soil, whilst Actinomyces and fungi show a rapid decline. Protozoa are also adversely affected, whilst the growth of yeasts is inhibited entirely. Some of the most prominent bacterial forms include *B. subtlis*, *B. graveolens*, *Sarcina*, and other forms yet unidentified.

Geology of the Orkneys. In a lecture delivered at the Geological Society on November 7, Sir John Flett announced that the geological survey of the Orkneys has now been completed on the six-inch scale, and that definite information has become available on many hitherto obscure or debatable points. The structure of the area is simple, and consists essentially of a broad gentle anticline in the West Mainland and a syncline in the North Isles. Scapa Flow is bounded on three sides by important faults. The basement rocks of granite and schist are exposed near Stromness and present many of the characters of the Strath Halladale granite and the Altnaharra type of Moines. Over a thin basal conglomerate lies a series of grey and blue flagstones probably 10,000 ft. thick with two well-defined fossiliferous horizons with *Pterichthys milleri* and *Coccosteus minor*. The Middle Old Red Eday beds are sandstones, flags and reddish marls, with a fish-bed containing *Tristichopterus alatus*. Basalt flows are present in this and the succeeding Hoy sandstones. Close correlation has been established between the Stromness, Rousay and Eday beds of Orkney and the corresponding Achanarras, Thurso and John o' Groats beds of Caithness. The Upper Old Red sandstones of Hoy, which are unfossiliferous and probably 4,000 ft. thick, are separated from the beds below by a great unconformity marking the erosion of thousands of feet of strata. Numerous dykes of bostonite, camptonite and monchiquite traverse both Middle and Upper Old Red Sandstone, but their age is still undetermined.

Submarine Terraces around Japan. In an interesting paper (*Earthq. Res. Inst. Bull.*, 12, 539–565; 1934), H. Yabe and R. Tayama describe the relief of the sea-bed around Japan and Korea. The coasts of both are surrounded by submarine terraces, from four to nine in number. The three upper terraces (of depths 0–30 m.) occur only in certain areas. The next three (of depths 40–60 m., 80–100 m. and 120–140 m.) are well developed in nearly all parts, the sixth attaining in one place a width of 15 km. Below this is a scarp always steep and distinct, that forms the outer margin of the continental shelf around Japan. The seventh terrace ranges in depth from 200 to 230 m., and in width to 20 km. The eighth and ninth terraces (of depths 300–350 m. and 600–800 m.) are limited in distribution. All the terraces are crossed by deep furrows lying along continuations of adjoining river-valleys, and not differing from them essentially, obviously submerged river-valleys. There are also what appear to be fault-valleys, etc., usually parallel to the general trend of the coast-line, especially on the Japan Sea side, while others, as in Sagami and Suruga Bays, trend radially to the coast.

Pressure Waves from Explosions. We have received from the Safety in Mines Research Board, Paper No. 88, "The Pressure Wave sent out by an Explosive" (3), by Messrs. W. Payman and D. W. Woodhead.

This is really a continuation of the investigation of the ignition of firedamp by coal-mining explosives, upon which one, at any rate, of the authors has been engaged for some years past. Previous investigations have led to the conclusion that these ignitions might be caused by flame from the explosive, the shock wave of the explosion or the projection of particles in a chemically active or an incandescent state. Although these factors are not really separable in practice, attempts have been made to examine them independently by experiment, and this paper is a preliminary account of the application of *Schlieren* photography to the waves sent out by working charges from blown-out shots of explosive either unstemmed or very slightly stemmed. The photographs show that, in addition to the main shock wave, there are certain conical prominences, of which two types appear to have been observed, namely *open* prominences and *cored* prominences. It would appear that the open ones are due to the projection at high speed of particles producing conical wave systems, whilst there is still some doubt as to the nature of the agent producing the cored prominences, two explanations being forthcoming. It cannot be said that any definite conclusions have yet been reached or that the investigation has up to the present yielded practical results, but, of course, it is scarcely fair to judge by such inconclusive experiments.

Segregation of Polonium in Bismuth Crystals. In order to explain the effect of impurities on the magnetic properties of bismuth crystals, Goetz and Focke assumed that the impurities segregated into a superlattice structure in the crystal. A. B. Focke has recently investigated this hypothesis by an ingenious method (*Phys. Rev.*, Oct. 1). A bismuth crystal is made containing polonium as an impurity, and the distribution of ranges among the polonium α-particles emitted normally from a crystal face is studied with a Geiger counter. Steps in the distribution curve indicate the presence of planes in the crystal in which the polonium is segregated. With a small concentration of polonium, the atoms of the latter were apparently segregated into small regions in planes spaced at $0 \cdot 54\,\mu$ separations parallel to the (111) planes and at $0 \cdot 90\,\mu$ separations parallel to the $(1\bar{1}1)$ planes. These separations are independent of the rate of growth of the crystal and of heat treatment. The addition of tellurium suppresses the layers parallel to the $(11\bar{1})$ planes and apparently gives a lamellar arrangement of the polonium atoms, with planes parallel to the (111) planes and having a separation of $1 \cdot 1\,\mu$.

Isotopic Ratio of Oxygen and the Atomic Weight of Hydrogen. The atomic weight of hydrogen determined by the mass-spectrograph is $1 \cdot 00778$ ($O^{16} = 16 \cdot 0000$), the values given by Aston and Bainbridge being in very close agreement. The value on the chemical standard, $O = 16 \cdot 00$, is obtained by dividing by the conversion factor, f, which is equal to the ratio of the physical atomic weight of oxygen to the chemical value. The physical atomic weight of oxygen is calculated from the ratio $O^{18} : O^{16}$, which according to Babcock (1929) is 1 : 1250, whilst Mecke and Childs (1932) give 1 : 630, and Aston (1932) 1 : 536. The value of Mecke and Childs gives $16 \cdot 0035$ for the atomic weight of oxygen ($O^{16} = 16 \cdot 0000$), and for the conversion factor, f, $1 \cdot 00022$. This gives $1 \cdot 00756$ for the atomic weight of hydrogen derived from the mass-spectrograph data, on the standard $O = 16 \cdot 00$. This value is considerably lower than the accepted chemical value. According to Moles, the mean of the values for the chemical atomic weight of hydrogen obtained by five different authors is $1 \cdot 00777 \pm 0 \cdot 00002$. In order to investigate this discrepancy, H. Muckenthaler (*Phys. Z.*, 35, 851 ; 1934) has re-determined the ratio $O^{18} : O^{16}$ by the mass-spectrograph, and has obtained a value of $1 : 1058 \pm 69$, the actual figures varying from 830 to 1300. Taking the ratio as 1 : 1000, the physical atomic weight of oxygen is $16 \cdot 00240$, and f is $1 \cdot 00015$. The atomic weight of hydrogen on the chemical standard would then be $1 \cdot 00778$ divided by $1 \cdot 00015$, that is, $1 \cdot 00763$, which is in better agreement with the chemical value. The author also describes experiments which indicate that the lighter isotope of hydrogen, H_2^1, diffuses more rapidly through heated palladium than the heavier isotope, H_2^2.

Petroleum Products as Insecticides. Under the auspices of the Institution of Petroleum Technologists, a useful paper on "The Utilisation of Petroleum Products as Horticultural Spray Materials" was read at a meeting at the Royal Society of Arts on November 13, 1934, by Dr. Hubert Martin of the Long Ashton Research Station, Bristol. Dr. Martin showed that the ovicidal and insecticidal properties of petroleum oil sprays applied to trees in winter are independent of the base of the oil, of its type of emulsification and of its viscosity over a wide range. Petroleum oils for summer insecticides must be highly refined, and their efficiency seems to depend upon a sufficient degree of viscosity, and upon a relative instability of the emulsifier. The relative values of several emulsifiers are described, and their use in combined insecticides is also reviewed. Petroleum oils can be used as 'wetters' or 'spreaders' for other insecticides, and this property was dealt with by Dr. Martin. The account should prove of great interest to scientific horticulturists.

Taste and Chemical Constitution. *Science Progress*, 29, No. 114, has an interesting article by Mr. A. J. Mee on "Taste and Chemical Constitution", in which he summarises the theories dependent upon the hypothesis that "taste must be a chemical sense, and must be conditioned . . . by chemical constitution". Physiologically, he points out, the sense of taste is similar to that of sight, but with less capacity for discriminating intensities, subject to large individual differences, and more easily fatigued than most of the other senses. There are five general classes of taste, namely sweet, bitter, salt, sour, and insipid. Acids taste sour, but vary considerably in the strength of solution in which they retain that taste. Taste has been attributed in the past to hydrogen ion concentration, but no quantitative relationship has been proved, and it is generally assumed that it is the combination of the anion and cation that determines the taste of a substance. The mixing of tastes is still not understood, but research has shown that sweet and bitter substances are often closely related chemically. Mr. Mee discusses the chemical possibilities in some detail. The chief difficulty lies in discovering the relationship between the arrangement of the groups in the molecule of the substance and its taste. The personal element, he declares, must be eliminated before the way is clear for research into the subject.

Chromosome Behaviour in Terms of Protein Pattern

By DR. D. M. WRINCH, Girton College, Cambridge, and Mathematical Institute, Oxford

CHROMOSOMES are molecular aggregates. An ultimate objective, both of cytology and of genetics, must therefore be to interpret their findings in terms of the molecular structure of chromosomes. If, as there seems reason to suppose, chromosomes consist substantially of aggregates of protein molecules in association with nucleic acid, the properties of such aggregates must inevitably determine the behaviour of chromosomes in general, the characteristics of individual chromosomes being attributable to the possession of individual protein patterns.

In view of recent advances in our knowledge of proteins[1], it is reasonable that an attempt should now be made to see how far the properties of chromosomes and the facts of genetics may be brought into relation with certain known facts of protein structure.

To this end a molecular model—however inadequate—must be constructed. The model consists of one or more two-dimensional sheets in the form of a long, worm-like, uni- or multi-molecular surface. The units which lie disposed, possibly helically, along the surface are homologous protein molecules of the classical type[2]—peptide linked amino acids—

. . . -NH-CO-CP-NH-CO-CQ-NH-CO-CR-NH- . . .

put end to end. In consequence, the specification of a chromosome will be in terms of the side chains . . . P Q R . . . belonging to molecules consisting of certain numbers of amino acid residues, and, in the most general case of n molecules, will consist of a linear sequence of n linear sequences

$$A_1B_1C_1 \ldots X_1Y_1Z_1A_2B_2C_2 \ldots X_nY_nZ_n.$$

Such an arrangement is in excellent accord with the structure recently proposed for clupein[3], the basic protein of herring sperm, since this structure is specified in terms of a sequence of side chains, namely,

$$\ldots . M\ A\ A\ M\ A\ A\ M\ A\ A \ldots .$$

with, in some cases,

$$\ldots . M\ A\ A\ A\ A\ M\ A\ A\ M\ A\ A\ A\ A\ ;$$

where A represents arginine and M some monoimino or monoamino-monocarboxylic acid. The specificity of a given chromosome may be regarded as an expression of its particular protein pattern. (The orderly arrangement of black and white notes on the keyboard of a piano provides a rough picture of what is meant.) Since arginine is known to be the major constituent in sperm of various species, an attractive hypothesis (as a first approximation) is to define chromosomes in such species as various sequences of M and A. Even if we maintain the ratio of 2 to 2·5 A molecules to one M molecule, as required by the chemical analysis of clupein, a considerable and presumably sufficient variety of sequences is available.

The end groups of the arginine side chains in the protein molecules[4] are completely ionised for $pH < 9$ and the four acidic groups in the molecules of nucleic acid[5] for $pH > 4$, and salt compounds will be formed. In the range pH 4 to pH7, nucleic acid has a variable *zwitterionisch* character, consequent upon the ionisation of the fifth acidic group ($pK = 6{\cdot}0$) and of the amino groups in cytosine ($pK = 4{\cdot}2$), in adenine ($pK = 3{\cdot}7$), and in guanosine ($pK = 2{\cdot}3$). The degree of ionisation of the end carboxyl and amino groups of the individual polypeptide chains (which in clupein are on the average 28 residues = 98 A. long[3]) is also variable in this range.

Cyclical changes in pH in this range are believed to occur during mitosis[6]: they would entail a cyclical variation in the degree of hydration of the molecular aggregate as a whole, which accords well with the swollen state of the chromosomes in early prophase[7,8], and with the severely dehydrated state of chromosomes at metaphase established by Belar in a classical experiment[9]. By analogy with keratin[10], the molecular aggregate may be regarded as being endowed with considerable powers of contraction, due to a number of different contractile factors. A cyclical change in pH suggests another technique of contraction, which in view of the facts of differential condensation (heteropycnosis)[11,12] is possibly the most important: for the change entails cyclical readjustments in the association of the protein chains with molecules present in the cytoplasm, in particular in the association with the molecules of nucleic acid. The *zwitterionisch* character[13] of molecules appears to provide a key to many cytological problems, notably to those concerned with the geometry[14] and dynamics[8,15] of chromosomes, which have recently been the subject of a number of cytological studies.

The model may also be studied in relation to the other essential properties of chromosome, namely, growth and division. The chromosome here pictured as a cylindrical mosaic or manifold—but with a radius running into thousands of angstroms—may add to its material by the wrapping round of new sheets, each new sheet being laid down over the old mosaic, as in the case of keratin[10]. Alternatively—and more probably—it may grow after the manner of a smectic crystal, such as a film of sodium oleate, where growth consists in other molecules slipping into their places and increasing the area[16]. The incorporation of sufficient new material would then lead to instability, the tendency to division being aggravated by a change in pH which gives the whole aggregate a larger net charge—and the molecular aggregate (now a charged shell) divides after the manner of a charged drop.

Our model is also of significance for genetics. Two chromosomes defined respectively by :—

$$A_1B_1C_1 \ldots . X_1Y_1Z_1A_2B_2C_2 \ldots . X_nY_nZ_n$$

$$A'_1B'_1C'_1 \ldots . X'_1Y'_1Z'_1A'_2B'_2C'_2 \ldots . X'_nY'_nZ'_n$$

will differ genetically if they differ in one or more members of their sequences. Genetics formally requires of a chromosome that it be specifiable as a sequence $a\ b\ c\ d \ldots x\ y\ z$ which is capable of certain types of behaviour, for example, fusion and fragmentation, represented respectively by :—

$$abcd\ldots p + qrstu\ldots xyz \rightleftharpoons abcd\ldots\ldots pqrstu\ldots\ldots xyz.$$

For the units $a\ b\ c$ an upper limit of 200–300 A. has been suggested by H. J. Muller and A. A. Prokofyeva[17]. We therefore identify a genetic character with a sequence of n residues: since the length of an amino acid residue[18] is 3·5 A., the upper limit would allow n to be anything up to 86. With this identification,

the phenomena of fusion and fragmentation fall neatly into place on the basis of the classical researches of Fischer, which would translate them into the form :—

$$\ldots \text{-CO-CP-NH}_2 + \text{COOH-CQ-NH-} \ldots \rightleftharpoons$$
$$\ldots \text{-CO-CP-NH-CO-CQ-NH-} \ldots + H_2O.$$

A detailed investigation will be published shortly, offering molecular interpretations of a number of genetic and cytological facts, including those relating to the nature of chromocentres, heterochromatin and euchromatin[19], the behaviour of the spindle attachment[8], the nature of chromomeres and of some of the forces between chromosomes[8]. The fundamental approach to the problem is clearly the study of the molecular structure of chromosomes by X-rays. Pending the necessary technical developments we must pursue our inquiries inductively. The central theme of the work—the chromosome as a crystal structure—gives unity and coherence to the task, the considerable body of knowledge of protein molecules in general, including those of globular type[20], providing a most admirable guide.

Happily, opportunities of testing the hypothesis are not wanting, those rendered possible by the new work on clupein[3] being specially attractive.

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[19] E. Heitz, "Die Herkunft der Chromocentren", *Planta*, **18**, 571–639; 1932. "Die somatische Heteropycnose bei *Drosophila melanogaster* und ihre genetische Bedeutung", *Z. Zellforsch. u. mikr. Anat.*, **20**, 237–287; 1933.

[20] J. D. Bernal and D. Crowfoot, NATURE, **133**, 794; 1934.

Brood Diseases of Bees

THE eighteenth of the Rothamsted conferences was held at the Experimental Station on May 19, 1934, under the chairmanship of Sir John Russell, and was devoted to papers and discussions on the brood diseases of the hive bee. Its proceedings have now been published under the title of "Brood Diseases of Bees".*

Notwithstanding the extensive researches which have been conducted on foul brood diseases of bees, the present knowledge of the subject is still very incomplete. Practically no scientific work has been done in Great Britain on brood diseases since 1885, and such information that is at present available is derived chiefly from the results of investigations carried out in other countries. The advisability of studying this subject in England has been recognised for some years by the Rothamsted authorities, and the advisory committee connected with the apicultural branch of the Experimental Station strongly urged that action should be taken.

Sir John Russell, in his introduction to the published report on the Conference, explains how the means for carrying out the necessary work was obtained. A decisive move was made by the British Bee Keepers' Association, which secured from its constituent bodies subscriptions enabling it to guarantee a sum of £250 a year for three years. An equivalent amount has been voted by the Agricultural Research Council, and a capital sum of £250, for the special equipment needed, has been obtained through the generosity of private benefactors. Dr. J. C. G. Ledingham, and the managers of the Lister Institute, have offered the use of their laboratories for any special bacteriological work required. The actual investigations started in the present year when Dr. H. L. A. Tarr was appointed in charge of the work. The Conference, it may be added, was called at the outset of the investigations in order to review the whole subject.

In the printed report, Mr. D. Morland contributes an article on the distribution of foul brood diseases in England, which is based on replies received in response to a questionnaire. The information received indicates the need for a full survey of the incidence, varieties and means of control of brood diseases, rather than any feeling that the data obtained is at all complete or that informants were always correct in their diagnoses. Other contributors discuss the historical aspect of our knowledge of brood diseases and the subject of legislation with reference to bee diseases in other countries. The possible benefit to be derived from legislation, as a means of controlling the spread of brood diseases, suggests itself when the success attendant upon such methods in Switzerland, for example, be taken into account. In reviewing the present position of the scientific study of foul brood diseases, Dr. Tarr lays stress upon the confusion that at present exists as regards this subject. American foul brood, European foul brood, sacbrood and rarer infections are individually discussed. The concluding article by Mr. D. Morland is essentially practical and summarises our knowledge with regard to the symptoms, means of prevention and current methods of treatment of the various diseases in question.

The papers contained in this report provide an excellent summary of the present status of the whole subject: they indicate what is already known and

* Rothamsted Conferences, 18: Brood Diseases of Bees. (Secretary, Rothamsted Experimental Station, Harpenden, Herts.) 1s. 6d.

where research is most needed. Whereas most investigators agree in ascribing American foul brood to *Bacillus larvæ*, the etiology of European foul brood remains much in doubt, and the problem is further complicated by the presence of 'secondary invaders' which have often been confused with the primary agent responsible for the disease. Whether this primary agent is *Bacillus pluton*, as it is generally regarded to be outside Britain, needs much investigation, and the work is hampered by the fact that there are evident difficulties attending its culture. With advance of bacteriological knowledge of the diseases in question, improved methods of diagnosis and treatment may be expected to result, and the work now being undertaken at Rothamsted is directed towards the solution of these problems. A. D. I.

Sleep and Hypnosis

IN an address on sleep and hypnosis delivered at a meeting of Section J (Psychology) of the British Association at Aberdeen, Dr. William Brown pointed out that although there are marked contrasts between hypnosis and sleep, there is also a close connexion. The muscles in sleep are in a state of relaxation, and in hypnosis in a state of rigidity. In sleep the knee-jerks become less pronounced and eventually disappear : in the hypnotic state, however deep, they remain undiminished. There are other differences ; for example, in sleep the subject is unable to respond to a suggestion to perform a simple act, whereas even in deep hypnosis such obedience is readily forthcoming. But in spite of these contrasts, Dr. Brown holds that there is a close connexion between the two states. Sleep can be induced by hypnotic suggestion even to the cure of some forms of insomnia, and the hypnotic state itself readily passes into a state of sleep. Sleep-walking is a spontaneously occurring phenomenon closely analogous to what is induced in a good hypnotic subject. A person who frequently walks in his sleep is, as a rule, exceptionally easy to hypnotise, and in the hypnotic state the dreams of the somnambulist may be recalled and the abnormal condition often rectified.

In inducing hypnosis, if the subject is instructed to relax and breathe deeply and regularly, the result is a close approximation to normal sleep, although the total state remains one of hypnosis, the knee-jerks being present, and the power to apprehend and react to the suggestions of the hypnotist continuing. In such a mild hypnoidal condition, the subject is unconscious of the outside world, but acutely aware of the hypnotist, and able to concentrate intensely upon certain suggested ideas. In this way, avoiding the unnecessary phenomenon of catalepsy, access may be obtained to some of the deeper levels of nerve function, and therapeutic adjustments can be made.

On the neurological side, the relationship between sleep and hypnosis is probably most accurately given by the theory of I. P. Pavlov, according to which both states involve internal inhibition in the cerebral cortex, spreading to the subcortical centres in the case of the former, and limited to the cortex in the case of the latter.

Mr. R. J. Bartlett reported on association tests with psychotic patients. In free association, complex indicators are progressively exaggerated with increasing mental disability, while, with controlled association, the difference from normality varies considerably, being greatest with opposites. Small but significant correlations were obtained between physicians' estimates and test scores, and there are indications that the work may prove of practical value in securing, for the physician, additional contact with the patient's mental troubles, and, for the patient, renewed contact with his own rational past.

Mechanisms of Cellular Respiration

IN his Croonian Lecture on the "Mechanisms of Cellular Respiration" delivered to the Royal Society on December 13, Prof. D. Keilin, Quick professor of biology and director of the Molteno Institute in the University of Cambridge, described in some detail the part played by cytochrome in the respiratory process. He said that cellular respiration consists essentially of the activation of metabolites by dehydrogenases and their coferments : the activated molecules are then oxidised by reacting with a suitable hydrogen acceptor, such as molecular oxygen, cytochrome, Warburg's yellow enzyme, oxidised glutathione, methylene blue or hydrogen peroxide. Of these, cytochrome, the yellow enzyme and glutathione can be re-oxidised by oxygen, thus acting as respiratory catalysts.

The most widely distributed respiratory system in aerobic cells is composed of dehydrogenase-substrate-cytochrome-oxidase-oxygen. Cytochrome is a mixture of three hæmochromogen compounds, with distinct absorption bands. Its reduction is inhibited by removal of metabolites or addition of narcotics : its oxidation is inhibited by poisons like potassium cyanide, hydrogen sulphide or carbon monoxide.

Haas, working in Warburg's laboratory, has recently arrived at the conclusion that the total respiration of starved yeast cells proceeds through cytochrome, as the result of experiments in which he estimated their cytochrome content, oxygen uptake and time of reduction of oxidised cytochrome after addition of potassium cyanide. The yellow enzyme of Warburg is composed of an active pigment group combined with a protein : it acts as a carrier between the activated metabolites and molecular oxygen. The leucoform is easily oxidised by methylene blue and oxygen and requires one molecule of oxygen per molecule of pigment : in the cells of baker's yeast, under aerobic conditions, it is responsible for only 0·5 per cent of the total oxygen uptake.

Certain dehydrogenases, such as xanthine oxidase and uricase, can react directly with oxygen, independently of carriers : both these enzymes are inhibited by potassium cyanide, but not by hydrogen sulphide or carbon monoxide, and both activate their metabolites ; in both systems molecular oxygen is reduced to hydrogen peroxide, which can bring about secondary or coupled oxidations. In the cells of certain bacteria, oxidations can take place anaerobically by reactions between two dehydrogenase systems, one metabolite acting as hydrogen donator and the other as hydrogen acceptor : for example, lactate is oxidised to pyruvate while fumarate is reduced to succinate.

University and Educational Intelligence

Bristol.—Dr. MacGregor Skene has been appointed Melville Wills professor of botany in succession to the late Prof. O. V. Darbishire. Dr. Skene, who is a graduate of Aberdeen, went to Bristol as senior lecturer in botany in 1926, and was made reader in that subject in 1929.

Edinburgh.—At a graduation ceremony on December 14, the degree of D.Sc. was conferred on Mowbray Ritchie for a thesis on reaction kinetics of photochemical and related systems, and on Alexander M. Smith for a thesis on variation in soil acidity, the protein content of oats and the *Aspergillus* method of soil analysis. The degree of Ph.D. was conferred on Alan Mozley (thesis—"The Fresh-Water and Terrestrial Mollusca of Northern Asia"), Margaret F. Ritchie (thesis—"Optical Rotatory Power of Organic Acids and their Derivatives"), George P. Sillitto (thesis—"Comparative Reactivities of Chlorine Atoms on Chlorobenzene"), R. P. Sinha (thesis—"Adsorption of Gases and Water by Coal"), and James S. A. Spreull (thesis—"Microscopic Structure of the Spleen of Domestic Animals").

The annual meeting of the Mathematical Association will be held at the Institute of Education, London, W.C.1, on January 7–8, when Mr. A. W. Siddons will take the presidency for the year 1935, in succession to Prof. E. H. Neville. The subject of the presidential address will be "The Food of the Gods". The following have been nominated for election as honorary members: Prof. E. Borel, University of Paris; Prof. J. Hadamard, University of Paris; Prof. G. H. Hardy, University of Cambridge; Prof. D. E. Smith, Columbia University; Prof. E. T. Whittaker, University of Edinburgh. Further information can be obtained from C. Pendlebury, 39 Burlington Road, Chiswick, London, W.4.

The small independent college in America, with its ideal of a 'liberal education', has no longer the unrivalled prestige it enjoyed for generations, but it still counts among the notable formative influences moulding the youth of that country. In *School and Society* of October 20 appear two addresses delivered at the installation of the twelfth president of one of those institutions—Union College, Schenectady, New York. The new president, after enlarging on the unique value of the small college and the dangers that threaten it, suggested that American Governments might well go further along the line of the British Government in providing competitive college scholarships. "If the state," he said, "is to dry up the old wells of philanthropy by confiscatory taxation —and at the present moment this might seem to some no mere hysterical fear—it might support the training of its leaders in just this way, through the subsidy of selected brains". The other address, by Dr. Nicholas Murray Butler, entitled "The Challenge to Education" aimed at rallying the forces of light and leading at a time when there is imminent danger of the submergence of much of the best of the nation's social heritage in a tide of blatant scepticism and disunion, part of the aftermath of the War. The best hope for the future is, he thinks, in the endowment with a liberal education of as many as possible of those who are capable of attaining to it.

Science News a Century Ago

Aurora Borealis seen at Woolwich

On December 23, 1834, William Sturgeon sent to the editors of the *Philosophical Magazine* an account of an aurora he had seen the previous evening. "A beautiful Aurora Borealis," he said, "was seen from this place last night. I was on Woolwich Common when I first saw it, then exactly six o'clock. It consisted of several groups of vertical beams of pale yellowish light on both sides of the north star, extending nearly to equal distances in the western and eastern directions. These beams presented the strongest light at their bases, and grew gradually fainter, to their superior extremities, here they softened and gently glided into the most attenuated light and were lost at various altitudes some of which were near to the zenith. . . . During the display of the fine streamers which first presented themselves about five minutes past six I hurried home to adjust a magnetic needle. It was about half past six before I had my magnetic apparatus fit for observation and the splendour of the aurora had now passed its meridian. I diligently watched the needle and the aurora until half past ten, but observed nothing in the motions of the former that could possibly be attributed to the influence of the latter."

Death of Malthus, December 29, 1834

The Rev. Thomas R. Malthus, the well-known writer on population problems, died at Bath on December 29, 1834. He was born on February 14, 1766, at the Rookery, near Dorking, then the property and home of his father. Educated privately in the first instance, Malthus entered Jesus College, Cambridge, in 1785, graduating ninth wrangler, and becoming in 1797 a fellow of his College. He was ordained in the Church of England, and for a time held a small living in Surrey. In 1805 Malthus was appointed professor of history and political economy at Haileybury College, Hertfordshire, the training centre for cadets of the East India Company. Here, throughout his life, he was able to pursue his researches upon the economic structure and implications of social life. Malthus joined the Statistical Society on its foundation in 1834; already, in 1819, he had been elected a fellow of the Royal Society, and, in that year, signed the charter book. In 1798 Malthus published his views in a work entitled, "An Essay on the Principle of Population as it affects the future Improvement of Society, with remarks on the Speculations of Mr. Godwin, M. Condorcet, and other Writers". Revised and enlarged editions of the treatise were the subject of his facile pen down to 1826. A passage that Darwin wrote in his autobiography ("Life") may be recalled here: "In October 1838 I happened to read for amusement 'Malthus on Population', and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species." Notwithstanding that much censure and calumny followed his published opinions, Malthus uniformly maintained composure and toleration, traits which were inherent in his character.

Societies and Academies

DUBLIN

Royal Irish Academy. J. J. NOLAN: A method for counting atmospheric ions and determining their mobility. A simple method is described by which accurate counts of atmospheric small ions may be made.

PARIS

Academy of Sciences, November 19 (*C.R.*, 199, 1077–1164). MARIN MOLLIARD and ALBERT CRÉPIN: The characters presented by green plants which develop in air enriched with carbon dioxide. A description, with reproductions of photographs, of the effects of atmospheres containing 0·5, 2 and 10 per cent of carbon dioxide on the radish. MAURICE GIGNOUX and LÉON MORET: The stratigraphy of the external edge of the Flysch zone of the Embrunais, between the Durance and the Drac (Piolit and Autanes massifs, Hautes-Alpes). E. MATHIAS: The idea of impurity in naked globular lightning. HANS SCHWERDTFEGER: Remarks on matrices with linear forms. D. PEREPELKINE: The directions of curvature of a Vm in Rn. M. HAIMOVICI: Some types of Finsler metrics. P. VINCENSINI: Deformable cyclic systems. ALBERT TOUSSAINT: Contribution to the study of the ground interaction for supporting wings. ROGER DUCHÈNE and JULES VERDIER: Forces resulting from knocking in (internal combustion) motors. Studies on the bouncing pin knockmeter. GEORGES DURAND: The application of the mass-luminosity relation to the calculation of the orbital elements of the spectroscopic double stars. NY TSI-ZE and TSIEN LING-CHAO: The laws of the disengagement of electricity by torsion in quartz crystals. CH. FABRY: Remarks on the preceding communication. Reference to the work of E. P. Tawil on the same subject. EDMOND ROUELLE: The transitory regimes produced on closing an oscillating circuit with an iron nucleus. G. KRAVTZOFF: The cathodic behaviour of the organic salts of copper. Study of the different factors. RENÉ LUCAS: The phenomena of optical mirage due to elastic waves. RENE FREYMANN and ARTHUR STIEBER: The effect of temperature and of visible and infra-red radiations on the electrical resistance of boron. The results of Weinstraub on the rapid variation of the electrical resistance of boron with temperature are confirmed. The changes in the resistance of boron when exposed to infra-red rays can be utilised for detecting radiation between 0·5μ and 0·85μ. GEORGES DÉJARDIN and MLLE. R. SCHWÉGLER: The luminescence excited by rolling mercury in a glass bulb containing impure neon under low pressure. Study of spectrograms obtained with this light source shows that, excluding known mercury lines, the spectrum is very similar to that of the aurora. Nearly all the lines can be attributed to either the atom or molecule of nitrogen. FRÉDÉRIC DIÉNERT and FERNAND VILLEMAINE: Contribution to the study of photo-chemical reactions. The action of phosphorous and hypophosphorous acids on uranyl salts. Uranyl salts are precipitated from acid solutions by sodium hypophosphite in sunlight: there is no apparent reaction in the dark. EDOUARD RENCKER: The dilatometric study of some ternary (soda, silica, alumina) glasses. FRANÇOIS CANAC: Study of the topography of certain surfaces from their coefficient of light diffusion. Application to the study of corrosion. WILFRIED HELLER and MICHAEL POLANYI: Quantitative studies of the reactions of atoms. IVAN PEYCHÈS: The Raman spectrum of tartaric acid and of tartrates in solution in water. Diagrams of the Raman spectra of tartaric acid, ethyl tartrate and six alkaline tartrates are reproduced, and the data briefly discussed. EUGÈNE DARMOIS and YEU KI HENG: The measurement of the strength of acids. A method is suggested based on the change in the rotatory power of solutions of ammonium tetramolybdate produced by the addition of acid. By this method, perchloric acid is stronger than benzenesulphonic acid. MME. SIMONNE ALLARD: The magnetic properties of a free radical, xanthyl-α-naphthylmethyl. From the measurement of the magnetic susceptibilities of solutions of dixanthyl-di-naphthylethane, it is deduced that 78–94 per cent is dissociated into the free radicle. This result is in agreement with the cryoscopic measurements of Gomberg. LÉON PIAUX: The Raman spectrum of some derivatives of cyclopentene. The synthesis of Δ.1-benzylcyclopentene. MLLE. BLANCHE GREDY: 3-cyclopentyl-1-propyne and some of its derivatives. Six new compounds are described with details of their Raman spectra. GEORGES DARZENS and ANDRÉ LÉVY: A new general method for the synthesis of tetrahydronaphthalenic acids and of naphthalene hydrocarbons. C. STANFIELD HITCHEN and RENÉ VAN AUBEL: The composition and age of crystalline uraninite from Katanga. From the results of spectrum analysis, it is concluded that this uraninite is a primary hydrothermal mineral. The lead–uranium ratio is 0·0863. PAUL FALLOT, LÉON MORET and EDOUARD ROCH: The Lias series of the Skoura country (Haut-Atlas marocain). JACQUES FROMAGET: The Trias in the Haut-Laos synclinal. JOSEPH BLAYAC and RODOLPHE BÖHM: A notable extension of the Ordovician in the eastern part of the Montagne Noire. MARCEL SOLIGNAC: Geological and hydrological results of No. 3 boring at Ben Gardane (Extrême-Sud-Tunisien). J. COULOMB and G. GRENET: The theory of seismographs with electromagnetic magnification. MLLE. MADELEINE FRIANT: The primitive type of the upper molars in rodents. KENNETH SMITH and JEAN DUFRENOY: The *Y*-virus of the Solanaceæ. The *Y*-virus tends to slow down the synthesis of the complexes forming the cytoplasm and hence to cause the accumulation of amino-acids. A. JUILLET and R. ZITTI: The seasonal variations of hydrocyanic acid in *Molinia cœrulea*. AUG. CHEVALIER: Preliminary sketch of the vegetation of the Cape Verde islands. J. BOUGET: The culture of potatoes from seed at Bagnères-de-Bigorre (560 metres). G. LEMÉE: The beech association in the Perche and the north-west of France. PHILIPPE JOYET-LAVERGNE: A new theory on the mechanism of intracellular oxido-reductions. E. GRYNFELTT: The modifications of the chondriome of the cells of the Flexner-Jobling tumour of albino rats in the course of their evolution.

CAPE TOWN

Royal Society of South Africa, October 17. F. R. C. REED: A new lamellibranch from the upper Dwyka beds of South-West Africa. S. HONIKMAN, H. A. SHAPIRO and H. ZWARENSTEIN: Variations in the ovarian response of *Xenopus* to the gonadokinetic principle of the anterior pituitary (1). Anterior pituitary extract assayed on frogs in July gave 265 units per gm. original tissue. A similar assay in October gave 77 units per gm. In July the ovary–body weight ratio was 110, in October, 80. The potencies of extracts from different batches of anterior

pituitaries prepared at the same time and assayed on animals from the same stock varies considerably. It would be premature to conclude that the correlation between the ovary-body weight and the number of units per gm. observed above is a true correlation.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 5). I. P. NATANSON: Note on the convergence of singular integrals. G. FICHTENHOLZ and L. KANTOROVICH: Some theorems on linear functionals. P. RACHEVSKIJ: The infinitesimal structure of the geodesic lines in two dimensions, considered with the approximation of the fourth order. G. GUREVITCH: (1) Some arithmetical invariants of a trivector and of a cubical shape. (2) Reduction of a trivector to a canonical form in a special case. E. BRUMBERG and S. VAVILOV: Statistical structure of the field of interference. A. ANSELM: Contribution to the theory of the surface ionisation of heated metals. N. FUCHS: Activation energy by evaporation and condensation. A. SOKOLSKIJ: Absolute method of determining the coefficients of viscosity in liquids. N. KALITIN: Diurnal and annual period of the long-wave solar radiation in the infra-red radiation is less than that in the case of total radiation, because of the effect of water vapour in the atmosphere. B. TARUSOV: Dielectric constant of muscle. The high value of the dielectric constant in a living muscle is probably connected with the presence of free salts, and changes with variations in their quantity. M. K. GRODZOVSKIJ and Z. TCHUCHANOV: Gasification of solid fuel. N. TAGEJEVA, S. ZEITLIN and A. MOROSOVA: Boron content of natural waters. Boron is a characteristic component of oil-well waters, probably connected with their geochemical history. J. TOLMACHEV and A. FILIPPOV: Presence of Rb, Be, Ga and Sr in nephelines. V. CHLOPIN: Geochemistry of helium. N. GORNOSTAEV: Geochemistry and tectonics of the gold quartz veins of the Soviet mine in the North Yenisseisky taiga. P. ZHIVAGO, B. MOROZOV and A. IVANITSKAJA: Influence of hypotony on cell division in the tissue cultures of embryonic heart. A. CHARIT and N. CHAUSTOV: Flavines and their determination in animal tissues. L. VARDANIANZ: Upper Jurassic orogenetic phases of the Caucasus. A. NIKIFOROVA: Contribution to the stratigraphy of the Upper Palæozoic of the north-eastern outskirts of the Great Donetz basin. A. TARANEC: A short review of the fishes of the genus *Gymnogobius*, with a description of one new species and notes on some related genera.

ROME

Royal National Academy of the Lincei: Communications received during the vacation. B. MANIÀ: The differential equations dependent on a curve. M. VILLA: The theory of hyper-algebraic hyper-surfaces. L. TOSCANO: The integration of recurrent successions of the second order, linear and homogeneous (2). C. SEVERINI: The double series of orthogonal and normal functions (2). A. ROSENBLATT: The equations to the partial derivatives of the parabolic type with two independent variables. L. PINCHERLE: The natural width of X-ray lines. An attempt is made to obtain theoretical justification for the results of recent measurements of the width of X-ray spectral lines on the basis of quantum mechanics. It is found that the natural width of the lines, taking account only of the probability of passage with emission of light, is in accord with the experimental data only for transitions of deep electrons of very heavy elements. In other cases, quantum jumps without radiation (Auger effect) must be taken into consideration; the influence of these suffices to explain satisfactorily the experimental data. U. FANO: The calculation of optical terms, in particular the ionisation potentials of bivalent metals, by means of Fermi's statistical potential. G. RACAH: The so-called electric moment of the electron. G. SCAGLIARINI and F. MONFORTE: The reaction between sodium nitritopentacyanide and alkali sulphides (4). The final product of the interaction of sodium nitropentacyanide and excess of potassium sulphide is an alkali sulphonitroprusside. E. PARISI and G. DE VITO: Contribution to the knowledge of the maturation of cheese. (1) Proteases, diketopiperazine and proline peptides. Ripe cheeses are found to contain compounds resistant to proteases, such as proline peptides and diketopiperazine, which have not hitherto been observed in cheese. The conclusion is drawn that the extent to which the casein of cheese undergoes degradation is closely related to the proportion of proline products present. GISELDA SERRA: Observations on the masticatory apparatus of the genus *Orthopsis*. G. MONTALENTI: Experimental parthenogenesis of the egg of the lamprey. C. GUARESCHI: Processes of regeneration and their limits in experiments on the centrifugation of the insect chrysalis. Centrifugal force acts on insect chrysalides as a disturbance of the metamorphic processes, tending to arrest or retard these according to the intensity and duration of the force applied and to the constitutional resistance of the individual. GIUSEPPINA DRAGONE-TESTI: Action of certain salts on the germination of embryos of grain outside the seeds. When added to Knop's solution, on which grain embryos are grown, various salts, particularly borax and zinc sulphate, exert a stimulating effect on the growth of the seedlings.

SYDNEY

Royal Society of New South Wales, October 3. A. H. VOISEY: The physiography of the middle north coast district of New South Wales. The main features are: (1) the dissected New England highlands, (2) an intermediate area of broad valleys in which the streams are entrenched, (3) coastal plains of accumulation with inliers of older rock, and (4) a coast-line of long curving beaches between rocky headlands. The coastal plain is particularly wide around the Macleay River, where the rocks eroded have been soft sandstones and tuffs. Submergence to the extent of at least 70 ft. is proved, and a small emergence is held to be responsible for rock-platforms, raised beaches, land-tied islands and other phenomena. There is strong evidence that this emergence has occurred during the period of human occupation. G. J. BURROWS: Some hydroxy salts of secondary and tertiary arsines. Although tertiary arsines are oxidised to arsine oxides or dihydroxy arsines when treated with permanganate or hydrogen peroxide, the mechanism of oxidation by moist atmospheric oxygen appears to be different. Thus a specimen of phenyl dimethyl arsine, on prolonged exposure to the air, was partly converted to phenyl methyl arsinic acid. Arsine oxides and arsinic acids combine with mineral acids to give stable crystalline salts with characteristic melting points. L. W. O. MARTIN: A theory of association. There are two theories of association. The dipole theory is found to be

unsatisfactory, and not in accordance with many observed facts. A development of Sidgwick's theory of chemical association is made, and a rule deduced giving conditions for such association. When two atoms of the same element can have a normal co-valent and a co-ordinate electron pair bond with the same atom, and if quantum numbers n and l are the same for both electron pairs, association follows, the association being stabilised by quantum mechanical resonance under certain conditions. HF, H_2O, HCl, ketones, oximes, carboxylic acids, esters, etc., are shown to fit in with the theory. A. R. PENFOLD, G. R. RAMAGE and J. L. SIMONSEN: The essential oil of *Calythrix tetragona*, var. 'A'. The leaves and terminal branchlets yield 0·7–1 per cent of an essential oil, the principal constituents of which are *d*-*a*-pinene, *d*-citronellol, *d*-citronellyl formate and the methyl esters of geranic and probably citronellic acids, the ester fraction comprising 60–70 per cent. This is the first natural occurrence of geranic acid which has been recorded.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 539–564, Oct. 15). R. H. SCIOBERETI: On the determination of the geocentric distance in the Laplace-Leuschner direct method for parabolic orbits. H. K. BENSON and A. M. PARTANSKY: The rate and extent of anaerobic decomposition of sulphite waste liquor by bacteria of sea-water mud. Liquor from a works manufacturing paper pulp by the acid sulphite process was used. Temperature of incubation and dilution of liquor governed rate of fermentation but did not affect extent of decomposition. 85 per cent of the reducing sugars was destroyed. The reduction products, methane and hydrogen sulphide, were preferentially formed while sulphide was available; the oxidation product was carbon dioxide. It is stated that the evolved gases, based on the yield with fermentation at 36° C., had a heating value of 649 B.T.U. per cubic foot. J. L. WALSH: Note on the location of the critical points of harmonic functions. E. D. GOLDSMITH: Correlation in planarian regeneration. Planarians were made double-headed by longitudinal splitting. Removal of one head may then be followed by complete, retarded or no regeneration of the head. Failure of regeneration is correlated with the presence of the remaining head. Frequency of regeneration was greatest in a zone lying between levels just posterior to the eyes and anterior to the pharynx. The effectiveness of this region is possibly correlated with high formative cell number and high (SH) content. F. B. SUMNER: Does 'protective coloration' protect? Results of some experiments with fishes and birds. Numbers of mosquito-fish (*Gambusia patruelis*) were placed in two cement tanks, one painted white, the other black. After seven or eight weeks, equal numbers of black-adapted and white-adapted fish were removed and placed in a whitish coloured tank and two Galapagos penguins were released in the tank to hunt and eat them. A similar experiment was tried in a black tank, and the interval between release of fish and birds was varied. Of the fish consumed in the whitish tank, 61 per cent were 'blacks', 38 per cent were 'whites' and 1 per cent unidentifiable; of those consumed in the black tank, 27 per cent were 'blacks' and 73 per cent were 'whites'. Hence fish that harmonise in shade with their immediate surroundings are less likely to be eaten by certain birds; coloration here has a definite survival value.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, December 23

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. Isabella Gordon: "Crustacea of the Deep Sea".*

Thursday, December 27

ROYAL INSTITUTION, at 3.—Prof. W. L. Bragg: "Electricity" (Christmas Juvenile Lectures. Succeeding lectures on December 29, January 1, 3, 5 and 8).

Official Publications Received

GREAT BRITAIN AND IRELAND

The National Smoke Abatement Society. Fifth Annual Report, 1934–5. Pp. 28. The Smokeless Home. Pp. 12. (Manchester: National Smoke Abatement Society.)

The National Institute of Industrial Psychology. Report 5: An Account of the Research Work carried out by the National Institute of Industrial Psychology during the Years 1921–34. Pp. 37. (London: National Institute of Industrial Psychology.) 2*s.* 6*d.*

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OTHER COUNTRIES

Report on the Administration of the Meteorological Department of the Government of India in 1933–34. Pp. ii+37+2 plates. (Delhi: Manager of Publications.) 1 rupee; 1*s.* 9*d.*

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U.S. Treasury Department: Public Health Service. Effect on the Eye of the Yellow Light of the Sodium Vapor Lamp. By James E. Ives. (Reprint No. 1640 from the Public Health Reports, Vol. 49, No. 32, August 10, 1934.) Pp. 9. (Washington, D.C.: Government Printing Office.) 5 cents.

CATALOGUES, ETC.

Conchology, Entomology, Geology, Ornithology, General Zoology, etc. (Catalogue No. 229.) Pp. 20. (London: Dulau and Co., Ltd.)

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No. 3400 Vol. 134

CONTENTS

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Industrial Psychology and Its Social Significance

THE last few years have seen a remarkable change in the public attitude towards industrial and commercial problems. In every country it has been recognised that many of the most difficult of these problems will be solved only by the application to them of psychological knowledge. It was with this fact in mind, and with a foresight which was well ahead of common opinion at the time, that Dr. C. S. Myers founded the National Institute of Industrial Psychology in 1921. From the beginning, it was realised that the work of the Institute would be two-fold: it must be of service to the particular employer of labour by helping him to attack his own special problems of factory or of industrial organisation, and it must at the same time set itself to stimulate and carry out research into problems of general industrial well-being.

Thirteen years have elapsed, and the Institute has now issued a report of its research work, a forecast of future activity and a plea for wider and more generous support*. The report is a striking and valuable document. On the side of specific factory or works investigations the Institute has proved itself, and is able to support a large and increasing body of trained consultants. But for the research work, which many rightly regard as of even greater significance, it must necessarily depend, and must probably continue to depend for a long time to come, upon public or private benefaction. Extremely valuable aid has been given by the Rockefeller and Carnegie Trustees; the former, for example, have "up to now given the Institute the total sum of over £22,000, mainly for research". Naturally this particular source of help cannot continue indefinitely. It has set the Institute upon its feet, and assisted its early steps towards the achievement of its aim. But now it is reasonably considered that others must help it along the way to complete success, for within two years the research work of the Institute must be seriously curtailed, or even cease, unless aid is forthcoming from other sources.

What, then, has been accomplished? The research work of the Institute, as revealed in this report, has been very varied, but it has developed

* An Account of the Research Work Carried out by the National Institute of Industrial Psychology during the years 1921–1934. Report 5 of the National Institute of Industrial Psychology, London, 1934. Pp. 37. 2s. 6d. net.

in the main along three lines: vocational guidance, a study of the abilities particularly required in industrial occupations and their training, and an analysis of human work involved in special industrial directions.

That everybody now knows at least something about vocational guidance is due largely to the enterprise of the Institute. Industrial organisation has increased vastly in complexity and in scope, but it has grown largely without foresight so far as its human problems are concerned—in a haphazard and hand-to-mouth fashion. Hundreds of thousands of young recruits pass into the industrial army every year. They have little direction, except that coming from local demands and immediate opportunity. The result is a great amount of muddle, of wasteful turnover from one occupation to another, of prolonged training resulting in the end often in only a moderate degree of efficiency. The ordinary methods of industrial recruitment rest upon an assumption of a versatility widely spread throughout an entire population which is, in fact, possessed only by the relatively few outstanding persons.

The Institute has carried out five large-scale experiments in order to see what hope there can be of avoiding the waste of human effort produced by lack of direction in industrial recruitment. It is claimed—and no careful and unbiased reader can fail to be impressed by the claim—that a study of the psychological and physiological equipment of young persons who are going into industry, of their aptitudes and of their capacities, of their temperament and of their ambitions, makes it possible to direct them in such a way that they can realise their possibilities more quickly and smoothly, with fewer false starts, with greater chance of ultimate efficiency, to the content both of themselves and of their employers and to the enhancement of the well-being of the community. The Institute has played a large part in proving the case for vocational guidance. The methods by which such guidance can itself be best directed still demand active research. It would be a disaster if the activities of the Institute to further this end were cramped by inadequate public support.

In spite of the rapid mechanisation of industry, manual dexterity in one form or another still plays a predominant part in industrial occupations. Rightly, therefore, the Institute has directed much research into an investigation of the nature and analysis of manual skill, of its general or specific character, and of the most fruitful ways by which it can be trained. It has shown again, what psychologists often have demonstrated in other directions, that mere repetition is a bad way to learn anything, and about the worst way of all to try to learn more than one thing. Its reports on the training of manual skill establish conclusions that are of importance in practically every factory in the country. But here, again, there is far more to discover than has as yet been made clear, and research must proceed if progress is to be made.

Of the study of somewhat more narrowly defined industrial problems: the effects of rhythm on work; the influence of visual factors in specific occupations, such as mining; the ways in which threatened boredom can be controlled and dispelled; the best working conditions in such abnormal groups as those of the blind; all that can be said here is that promising work has been initiated and carried through. The investigations touching upon these matters, and many others as well, are considered and described in the report.

In the thirteen years of its existence, the Institute has accomplished a very great and important amount of work. It has powerfully assisted many movements which have given to psychology a social significance altogether out of proportion to the number of people engaged upon the exact investigation of its problems, or to the amount of private and public financial assistance that it is accorded. Nowadays, psychologists are asked to comment upon and even to settle almost every problem of social and public import that arises. If their answers are halting and inadequate—as they very often must be—it is because methods for the collection of data in an exact manner have only recently been devised, and because psychology is, of all sciences, physical or biological, the one which has been most hampered for lack of funds to prosecute research. Both in the case of the National Institute of Industrial Psychology and elsewhere, what has been done has often been accomplished only because trained students have been willing to devote themselves, freely, or for inadequate payment, to the study of pressing social problems. The claim made by the Principal of the Institute for more generous financial assistance is no longer based upon promise alone, but upon substantial performance, and we hope that it will receive a widespread and a ready response.

Geography of Human Endeavour

Economic and Social Geography. By Ellsworth Huntington, Frank E. Williams and Samuel van Valkenburg. Pp. xi+630. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 23*s*. net.

A BOOK by Prof. Huntington is expected to be stimulating and suggestive, and even if a reader disagrees with a good deal (as easily may happen) the encounter is always worth while. When in addition Profs. Williams and van Valkenburg are collaborating, a book worth reading is assured.

Broadly speaking, the present volume deals with those geographical facts and principles that underlie all the major normal activities of the human race. Food production naturally comes in for the greatest share of space, because the extent to which this can be accomplished in any particular region has in the main determined the distribution of population on the earth, and therefore the extent to which man has altered the face of the earth to make it better suited to his real or fancied requirements. Industry and commerce receive little more than 100 pages; yet so well is the subject matter presented that one feels no distortion of perspective.

The book opens with a discussion of the effect of climatic factors on the growth of crops as food for men and animals, on the distribution of men and animals over the surface of the earth and on numerous human attributes, activities and happenings. It is fully illustrated with maps and charts presenting several novel features—including the cutting out of much of the oceans so as to give more space for the land areas. Some of these show the relation of climate to health and disease, to prosperity and mobility, numbers of motor-cars, education, the liberal professions, and such minor events as convictions for drunkenness, illegitimacy and suicide. The discussions on climate have the special feature that full use is made of the ingenious climatographs or, as the authors prefer to call them, the "climographs" already known to geographers through the advocacy of Griffith Taylor. The mean monthly temperatures are plotted on a vertical scale, the mean monthly rainfalls on the horizontal scale, then the points for the various months with the names of the months written alongside of them are joined, making an irregularly shaped figure which shows at once the general character of the climate and enables comparisons with other regions to be easily made.

The agricultural maps include some interesting isopleths, or 'lines of equal productivity', drawn through points where the average yields over a long period are the same. One thus sees at a glance the fertility levels; these are marked off and shaded just as in an ordinary contour map. The authors proceed to combine the 'isopleths' with the 'climographs' and so obtain isopleth climographs which show the relation of temperature and rainfall to crop yields One such chart is drawn for maize for each of the four seasons beginning with winter (December, January, February). The results are exceedingly interesting: they show, as one might expect, that the conditions for high yield are very narrow, but for low yields they widen out to the limits of tolerance for the crop. This method of treatment deserves serious attention not only from geographers, but also from agriculturists.

From the various data accumulated in regard to human health and activity a map is drawn up showing the distribution of 'climatic energy', that is, the energy that human beings would have if climate were the only determining factor. This makes an interesting study. The densest portions, that is, the optimal regions, centre round the North Sea, around the Great Lakes in North America, and in smaller regions on the Pacific coast of North America, and in an area including the south-eastern corner of Australia, Tasmania and New Zealand. Next, with somewhat less climatic energy, come the remainder of Europe including Russia, and the rest of the northern United States and southern Canada, a belt near the south of South America, part of South Africa, the southern part of Australia and Japan. The least satisfactory are of course the desert regions.

One would have liked clearer information about the primary data on which the map is constructed: it certainly forms the basis of a stimulating chapter. The map is closely similar, as might be expected, to one showing the number of persons of all ages in educational institutes calculated per hundred children aged 5–14 years, and to another showing the number of occupied men in the liberal professions including doctors, lawyers, clergymen, teachers, engineers and artists. Charts are drawn showing how drunkenness, suicide and illegitimacy vary in the opposite way, and decline as one moves from the regions of lower to those of higher 'climatic energy'.

Similar maps are constructed for the distribution and the efficiency of animals. A climograph of the number of eggs laid per month in the Storrs contest shows clearly the effect of temperature and rainfall conditions: the isopleths of egg-production in the United States bring out further information of great interest to poultry students; incidentally, the Englishman who has travelled much in the States will find the solution of many a mystery in the authors' terse statement that a chicken is defined in the U.S. census as "any fowl

of the chicken species over three months of age".

Having set out in great detail the general relations of climate, soil and other geographical factors to human activity and crop and animal growth, the authors proceed to discuss the natural regions of the world; they group them as low latitudes, including wet tropical forest, dry tropical forest and savannah, deserts, grassland, mediterranean and mild east coast regions; and higher latitudes. Detailed studies of American regions are given. Then comes a very interesting section on the great products of the world: the food-stuffs, oils, industrial crops, timber, minerals and fuels; and finally, a section on industry and commerce.

The book can be strongly recommended to the student for its interesting presentation of many facts both new and old, for its stimulating and suggestive generalisations, and for the clear relations it brings out between geographical factors and human activity. E. J. RUSSELL.

History of Theories of the Origin of Ore Deposits

(1) *Bulletin of the Geological Society of America.* Vol. 45, No. 3: *Origin and Nature of Ore Deposits: an Historical Study.* By Frank Dawson Adams. Pp. 375–424. (New York: Geological Society of America, 1934.)

(2) *History of the Theory of Ore Deposits: with a Chapter on the Rise of Petrology.* By Thomas Crook. Pp. 163. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., Inc., 1933.) 10*s.* 6*d.* net.

SO far as the present writer is aware, no previous publication has appeared in the English language dealing exclusively with the history of theories of the origin and formation of ore deposits. By a coincidence, two essays on the subject have appeared almost simultaneously. Their authors fortunately have approached the subject at different angles, and the essays are to a large extent complementary. Dr. Adams describes especially the ideas on the subject contained in the literature prior to the nineteenth century, covering the ground from the time of Aristotle to that of Hutton and Werner. Mr. Crook, on the other hand, follows up a comparatively brief sketch of the theories of the early writers by a detailed study of those current from the beginning of the nineteenth century onwards.

The importance of ores and minerals to human welfare is such that speculation as to their origin was aroused at an early date. The first European reference to the subject is stated to be that occurring in the writings of Aristotle. Early theories were of a highly speculative and fantastic nature, and the advent of printing caused them to be widely circulated and perpetuated. It was long believed, for example, that metals and ores grew and increased in the earth by processes analogous to those of the vegetable kingdom; there was, too, a belief that the baser metals were continuously undergoing a gradual transformation into the nobler metals silver and gold.

It was not until the middle of the sixteenth century that any important book on ore deposits appeared, the contents of which were based on actual observation of mining operations. About this time Georgius Agricola, who like many early writers on science was a physician, took up residence in the mining town of Joachimsthal, Saxony. While practising among the miners he took full advantage of the opportunity afforded him to study ore deposits. In 1546 he produced a book, "De Ortu et Causis Subterraneorum", containing the germs of two great theories as to the origin of ore deposits, namely, the theory of ascension and that of lateral secretion. These theories, however, were not to take definite form until some three hundred years later.

About one hundred years after the time of Agricola, shortly after the formation of the Royal Society of London, Robert Boyle drew up, at the instance of the Society, a long questionnaire designed to obtain from mine managers in Great Britain and abroad information concerning the nature and mode of occurrence of ores and other minerals. This questionnaire, which would require little modification to make it useful to-day, shows that the men of science of the period were keenly interested in the subject of ore deposits. Nevertheless, several of the questions make it evident that even the most astute minds of that time were still influenced by the curious beliefs perpetuated in the literature on the subject. It is indeed amusing to find the great Boyle asking: "Whether the Diggers do ever really meet with any subterraneous *Daemons*; and if they do, in what shape and manner they appear; and what they portend; and what they do, &c."

During the eighteenth century, though belief in the old conjectural ideas still lingered on, rational theories were beginning to be evolved. At the end of the eighteenth century there emerged in recognisable form the three theories which are still current to-day, namely, those of ascension, lateral secretion and magmatic segregation.

Dr. Adams has written an extremely interesting and informative account of the speculations of the early philosophers, astrologers, alchemists and miners. He is the possessor of an extensive collection of early works on geology, mining and related subjects, and evidently his paper is the

result of much patient and enthusiastic research in his library.

Mr. Crook carries on the story in a carefully documented study of the developments of various theories advocated during the nineteenth and twentieth centuries. To-day it is generally believed that the genesis of many types of primary ore deposits is connected with igneous activity, though there is still a great variety of opinion among competent authorities. Mr. Crook, while he deals fully with the development and recurrence of this view, will himself have none of it. He maintains that the concentration of ores and minerals in almost all deposits is most probably due to exogene action. Disagreement with his point of view does not detract from the value of his book as a historical study. It is most interesting to be taken back through the years and to find that there is often nothing essentially new in modern theories. So long ago as 1644, for example, Descartes suggested that metalliferous veins were derived from the molten interior of a partly cooled earth. World-wide mining operations have, however, accumulated observations and facts in support of theories formerly based only on speculation.

The nature of many ore deposits is such that it is unlikely that the truth as to their ultimate origin and mode of formation will ever be known. As Dr. Adams points out, though much has been learned, much remains to be discovered, and the subject is one in which less progress has been made since the Middle Ages than is the case in most other branches of geology.

Neither Dr. Adams nor Mr. Crook mentions the works of Gabriel Plattes, possibly the earliest English writer to produce a book on ore deposits. In 1639 this author published a work entitled "A Discovery of Subterraneall Treasure, viz., Of all manner of Mines and Mineralls, from the Gold to the Coale ; with plaine Directions and Rules for the finding of them in all Kingdomes and Countries". Several observations of his make it clear that he was an original thinker and a keen observer of geological phenomena. The theory of the origin of mineral veins which he describes corresponds crudely to the modern theory of ascension. While this is possibly even at that date not original, what is remarkable is that he describes a laboratory experiment in which he attempts to prove its truth. In this respect he is a forerunner of Sir James Hall, who has generally been regarded as the pioneer of experimental geology.

In the last chapter of his book Mr. Crook describes the rise of the science of petrology during the first half of the nineteenth century. After about 1860, the tendency to treat the study of ore deposits as separate from that of petrology became evident. To-day petrologists study the silicate and sedimentary rocks in great detail, but often with little or no interest in the petrology of the metalliferous vein and other ore deposits. Mr. Crook's object in writing this chapter is to deplore this separation of the study of ore deposits from that of the science of petrology, of which it ought to form an important branch. This is a point of view with which many will agree.

Two errors were noticed in reading these essays. In Dr. Adams's paper the reference to the *Phil. Trans. Roy. Soc.*, given in a footnote on p. 393, should be to p. 330 (not 328). In Mr. Crook's book the date of publication of John Woodward's "Essay Towards a Natural History of the Earth" is given as 1665, a misprint for 1695. V. A. E.

Modern Tendencies in Optics

(1) *Mirrors, Prisms and Lenses : a Text-Book of Geometrical Optics.* By Prof. James P. C. Southall. Third edition. Pp. xxv+806+8 plates. (New York : The Macmillan Co., 1933.) 22*s.* 6*d.* net.

(2) *Optics.* By W. H. A. Fincham. Pp. vi+462+6 plates. (London : Hatton Press, Ltd., 1934.) 18*s.* net.

"OF the making of books," said Solomon, "there is no end, . . ." We forbear to finish his quotation, but could he have lived to see the catalogue of a modern publisher his conclusion might have been expressed even more strongly. The flowing tide of books is, of course, only a reflection of the spread of science, a flood which submerges old boundaries, and is ever cutting new channels for its onward rush.

The subject of 'geometrical optics' occupied, a few years ago, a select position as a branch of mathematics taught in certain cases, we are told, by academic gentlemen to whom the sight of a real lens would give a mild shock. When the mathematicians left the subject largely to the physicists, the latter usually found themselves much too busy to study it except in so far as it was necessary for the comprehension of various instruments, and only then in close conjunction with the principles of physical optics.

(1) Prof. Southall's valuable book, first published in 1918, appeared at a time when optical studies had been wakened into feverish activity through the exigencies of the War, and aimed at giving a clear and systematic general account of the geometrical principles of the fundamental constituents of optical instruments—"Mirrors, Prisms and Lenses"—and did not attempt to deal more than briefly with complete optical systems.

The later editions, however, while indicating the well-deserved success of a thorough and consistent piece of work, illustrate very well the tendency which has been indicated above. We now find far more attention paid to the physical sides of the subject. There is a chapter on the microscope included as typical of optical instruments, and another on subjects connected with vision, such as binocular vision, visual acuity, colour vision and the like.

We wish that Prof. Southall had had the courage to go even further, and to include chapters on other instruments as well, since purely geometrical discussions are apt to appear tiresome unless studied in connexion with real instruments, and moreover the chapter on the microscope is written with skill and charm. Moreover, one does not go far with the microscope before feeling the need of a little systematic discussion of photometric principles; this would have made the treatment of light transmission by the instrument much more intelligible. For reasons such as this, we feel that the form of the book is in a transitional stage.

Where the general standard is so high, the one or two defects noticed can only be mentioned in a helpful, and by no means critical, spirit. The amusing misprint on p. 684, *dark-yield illumination* (sic.), is a unique example of a measure of truth emerging from a printer's error. There are statements in the section on "Colour" which might be challenged. For example, there may be a great difference of hue between a sunlit lawn and grass in shade, especially if the shadow is illuminated by light from a blue sky; the difference is not necessarily one of brightness only, as stated. A little lower we read: "If blackness were simply the absence of all sensation, that is a purely negative thing, the objects behind our eyes ought to look black; which is absurd of course."

This last argument seems to be rather unsuited to elementary notes on colour vision; to begin with, it seems to confuse zero and negative quantities. Since negative quantities may have some meaning in respect of colour stimulation, if not of sensation, the phrasing is not happily chosen. But surely 'blackness' can only be an attribute of a part of the possible visual field, in which the images of objects behind our backs have no place!

(2) Mr. Fincham's "Optics" aims at roughly the same standard as Prof. Southall's book (university intermediate), but devotes much more attention to physical optics, interference, diffraction and the like; and the geometrical treatment of the Gaussian theory is not so extensive. The text is based on lectures delivered in the Applied Optics Department of the Northampton Polytechnic, and is the product of a good many years' experience of teaching in a technical school. It is intended to cover the work required by a student before he begins to specialise in ophthalmic optics, or in optical instrument design.

The book is clearly and accurately written, and contains a large number of examples, that it should make a very useful class book. The emphasis given to the physical and geometrical sides of optics is well balanced, and well suited to the needs of those who are going to specialise in some branch of the subject.

Unfortunately, it cannot be said that the book is satisfactorily printed; the pages are badly cut with respect to the lettering, the mathematics is set in very thin type, and several of the diagrams are reproduced on a scale so small as to be confusing. There is a number of good half-tone plates of diffraction phenomena, etc.

Both these books use the ordinary Cartesian sign convention for distances, the positive direction being that of the incident light, but the definitions of the 'focal lengths' differ, though they both agree in assigning a positive power to a 'converging' lens. The object-space focal length agrees in sign with the power in Prof. Southall's book, and the image-space focal length takes the sign of the power in Mr. Fincham's.

L. C. MARTIN.

Short Notices

The Lyophilic Colloids (*their Theory and Practice*). By Prof. Martin H. Fischer and Marian O. Hooker. Pp. viii+246+24 plates. (London: Baillière, Tindall and Cox, 1933.) 22*s*. 6*d*.

THE greater part of this book is given up to a restatement of the theory of the general nature of lyophilic colloids proposed by the authors fifteen years ago, together with the considerable bulk of evidence supporting it. The most important section, however, is that in which the biological applications of the theory are considered. In brief, protoplasm is to be regarded, not as water containing certain substances, but as a combination of those substances forming a base-protein-acid compound with water 'dissolved' in it as an integral part. The difference is the same as that between water containing dissolved soap or phenol, and a solution of water in soap or phenol. It follows that the laws governing the behaviour of substances in dilute solution, such as the laws of diffusion and osmotic pressure, cannot be applied, as physiologists and pathologists still apply them, to protoplasm, which has the characteristics of a lyophilic colloid.

The biological corollaries to the theory are drastic

enough. Thus if the water in protoplasm is in combined form, living material within the cell is for all practical purposes anhydrous, and synthesis in the cell takes place in an anhydrous medium. This explains why the chemist, using watery solutions, finds it so difficult to synthesise the complex proteins formed easily by living tissue, when he can readily break down natural products in the aqueous medium which Nature also uses when analysing. The least convincing chapter is that in which the pathological condition of œdema is explained on the basis of increased capacity of tissue colloids for holding water, this taking place when acid accumulates in the tissues. The reasoning from œdema in "organisms [plants] possessed of no circulation" will surprise students of botany; the summary dismissal of hydrostatics and permeability from the picture, and the installation of colloid chemical properties as the root of the problem, will lead the clinician to ask why œdema appears first in the feet when the 'pump' is inefficient, and what colloid retains water in the peritoneal and pleural cavities when ascites and hydro-thorax complicate severe œdema.

An erroneous or perhaps too hasty application of the argument to an isolated case does not, however, invalidate the theory, and the authors may be congratulated on having shown physiologists and biochemists a new route to the possible solution of their problems.

Asymmetric Synthesis and Asymmetric Induction: based on a Thesis for the Degree of Doctor of Philosophy presented to the University of St. Andrews in March 1932. By Dr. Patrick D. Ritchie. (St. Andrews University Publication No. 36.) (Published for St. Andrews University.) Pp. x+155. (London: Oxford University Press, 1933.) 7*s*. 6*d*. net.

ONE by one the barriers presumed to exist between the chemical processes of the living cell and those of the laboratory are being shown to be unreal. Wöhler in 1828 converted ammonium cyanate into urea, a typical *organic* compound. Later, tartaric acid, a product of the fermentation of grape juice, was synthesised in the laboratory, but Pasteur showed that the synthetic acid was composed of two chemically identical dissymmetric forms and was therefore optically inactive, whereas during fermentation only one of these optically active forms is produced. Either a living organism or a pre-formed optically active substance was found necessary to effect the separation of the synthetic mixture, and Pasteur concluded that until some dissymmetric agency was developed in the laboratory the synthesis of optically active molecules would remain the prerogative of life.

The monograph under notice contains a careful and detailed account of the numerous investigations undertaken to produce optically active compounds by laboratory methods, culminating in the successful application of circularly polarised light by Kuhn (1929–30) and Mitchell (1930) to effect the preferential photochemical decomposition of mixtures of dissymmetric compounds.

The allied problem of asymmetric induction or the generation of a second optically active centre in a molecule under the directive influence of a pre-existing asymmetric centre is also dealt with in a very competent manner—the extended researches of Prof. McKenzie and his co-workers in these fields receiving careful and critical consideration.

(1) *Thermochimie.* Par Prof. W. Swietoslawski. Traduit par M. Thon. (Union française: Comité l'expansion du livre scientifique.) Pp. xix+379. (Paris: Félix Alcan, 1933.) 60 francs.

(2) *Union Internationale de Chimie. Premier Rapport de la Commission Permanente de Thermochimie.* Text by W. Swietoslawski and L. Keffler. Pp. 33. (Paris: Union Internationale de Chimie, 49 Rue des Mathurins, 1934.)

(1) SINCE the appearance of the memoirs of Thomsen and of Berthelot, the subject of thermochemistry has made very considerable advances, and the new treatise by Prof. Swietoslawski is a welcome addition to the literature of physical chemistry. It deals with the experimental aspects of the subject in a very comprehensive manner, including recent advances in calorimetry, and then discusses the results for a number of classes of compounds. Theoretical considerations receive adequate treatment, and full references to the literature are given.

(2) The report of the International Union, the text of which is in French, English and German, deals with units, thermochemical standards and the calibration of bomb calorimeters, including corrections and calculations. At the end is a suggested list of data which should always be given in recording the determinations of heats of combustion. The Commission considers that, in order to avoid a lack of homogeneity in the results obtained from measurements of heats of combustion, all calorimeters used for the determination of heats of combustion of pure substances or fuels should be calibrated by means of benzoic acid for solid and liquid substances by means of the bomb, and hydrogen for the determination of heats of combustion of gases or vapours by means of the flame calorimeter. Very full details of units, control of purity and methods of calculation are given.

Aristotle: Fundamentals of the History of his Development. By Werner Jaeger. Translated with the Author's corrections and additions by Richard Robinson. Pp. vi+410. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 18*s*. net.

THIS excellent translation of Prof. Jaeger's work will bring within a much wider circle of scholars the results of his important researches. These suggest three successive phases in Aristotle's intellectual development: (1) an early Platonic stage during the time he was a student in the Academy; (2) a transitional stage in which Aristotle, though still considering himself a Platonist, had abandoned the theory of ideas for his own metaphysics; and (3) the period commencing with his final return to Athens, in which his scientific researches inspired his empirical outlook.

Recent Glacier Survey

By Dr. A. E. H. Tutton, F.R.S.

THE movements of the glaciers of the European Alps are a perennial source of interest, which has increased of late years, more or less in proportion to the large increase in the number of climbers, skiers, summer holiday-makers and winter-sports visitors. During the same time there has been an immense improvement in the organisation of the systematic study of glacier motion, by the formation of national and international glacier commissions. The Governments of Switzerland, France and Italy in particular have now regular officials of the State engaged in effecting definite observations, surveys and measurements, and reports are issued at stated intervals, of both scientific and general interest. For example, the fifty-fourth annual report, for the year 1933, of "Les Variations periodiques des Glaciers des Alpes Suisses", edited by Prof. P. L. Mercanton, chairman of the Commission Suisse des Glaciers and professor of geophysics at Lausanne, has recently been issued. The observations were made by cantonal forestry officials. Also the Département des Eaux et Forêts of the French Ministry of Agriculture has just issued a voluminous report on the work carried out during 1920–30 on the glaciers of Savoy, Dauphiny and the Tarantaise, under the direction of M. P. Mougin, inspecteur general des eaux et forêts*. One is sorry to learn that M. Mougin has now retired from the post which he has so long and ably filled. In a very kindly letter to the writer, he has given further details of the work, bringing it up to 1933, and thus rendering it comparable with that of Prof. Mercanton, as regards the glaciers of the Mont Blanc chain. The Italian glacier surveys are likewise carried out by specially trained departmental officers of Piedmont and Lombardy.

This glacier research is not merely of scientific, geographic, geodesic and geophysical importance, but has also been the means of preventing the recurrence of those terrible calamities, generally due to the formation and bursting of lakes and water-pockets in the glaciers, which so frequently in the past have appalled the world and brought destruction to whole villages and districts in the Alps; for example, those of 1818, 1898 and 1892, due to lakes and immense pockets in the glaciers of Giétroz, Crête Seche and Tête Rousse. Indeed, I was myself a spectator immediately afterwards in the last instance, and well remember the terrible havoc, and the immense gap in the glacier de Bionnassay, where the torrent from the Tête Rousse had torn a great portion of the glacier away. The scene at the village of Bionay and at what had been the Baths of St. Gervais, where a hundred and fifty persons had been killed or drowned, was very harrowing. Thanks to these researches, however, siphoning trenches and other suitable means are now constructed and provided in time to obviate such disasters completely, the imprisoned water being released automatically, when the crisis comes, harmlessly and effectually.

It may also not be out of place to mention that careful research is now being carried out concerning snow and ice avalanches, their nature and causes, and not only the best means of avoiding them but also of foreseeing them. On this subject, an admirable article, beautifully illustrated by actual photographs, is contributed by Mr. Gerald Seligman to the 1934 issue of the "British Ski Year-Book".

The usual geodesic and theodolitic methods of glacier survey have now been supplemented by determinations of the annual change in the bulk of the ice and snow, by the regular reading of immense vertical scales, nivometers, engraved on upwards-projecting rocks. These nivometers have during these last two years been read and photographed from aeroplanes, Prof. Mercanton having had the advantage of being taken up by some of the most skilful of the Swiss pilots. Fig. 1 is a reproduction of an aerophotograph taken near the nivometer of the Glacier d'Orny, by Prof. Mercanton, piloted on this occasion by M. Champod. It shows the Saleinaz, d'Orny and Trient group of peaks and glaciers at the north end of the Mont Blanc chain. Efforts have also been made to ascertain the inner movements in the depths of glaciers. For example, Prof. Mercanton and his staff have sunk a considerable number of 75 mm. shells in the Rhone and Great Aletsch Glaciers, each having an identity piece sealed within it, and a sequence number deeply engraved on its outside: the initial position of each was accurately recorded, with reference to fixed marks on adjacent rocks.

Moreover, actual measurements of the daily movements of the extremities (snouts) of glaciers have been made with the aid of the ingenious little instrument devised by Prof. Mercanton—the cryocinemeter. These latter measurements, and the new depth-sounding work (determining the thickness of a glacier) by the seismographic method, are particularly interesting. In these latter determinations the length of path of a seismic wave produced by an explosion between surface and rock-bed, is ascertained with the aid

* Ministère de l'Agriculture: Direction des Eaux et du Génie rural. Études glaciologiques, 1920–1930. Par P. Mougin. Tome 7. Pp. vii+306+76 plates. (Paris: Imprimerie Nationale, 1933.)

of a modified form of earthquake seismometer. The many attempts which have been made to employ depth-sounding hydrophones, ultrasones and piezo-electric apparatus have not met with success, and it was a happy thought of Dr. Mothes to adapt the earthquake seismometer to the problem. A photographic recorder for the vertical component and a microphonic attachment are the chief modifications necessary. The time taken by the explosion wave to pass through the thickness of the glacier and to be echoed back to the surface is determined, both the longitudinal waves and the transverse vibrations being recorded; and from the previously determined velocity of the waves the thickness of the ice can be immediately calculated. Dr. Mothes first employed this method on the Hintereisferner, and in 1929 on the Great Aletsch glacier, near the Concordia hut, where a depth of no less than 700 m. was found, greatly exceeding the 200 m. found by the late M. Joseph Vallot on the Mer de Glace.

Passing now to the main results of the latest surveys, the following table gives them for the last eight years (1926–33), for one hundred Swiss glaciers.

Year	Growing (advancing)	Stationary	Decreasing (in retreat)
1926	52	8	40
1927	22	7	71
1928	14	5	81
1929	11	12	77
1930	8	12	80
1931	22	12	66
1932	13	7	80
1933	15	4	81

The preponderating phenomenon is thus that of retreat; that is, the position of the extremity of the snout of the glacier has retrogressed higher up the glacier valley, the total length of the glacier being reduced. As regards the amounts of retreat in the cases of the more famous glaciers they are:—The Rhone glacier 9 m., Fiesch 11 m., Aletsch 3 m., Allalin 10 m., Fee 7 m., Gorner 11 m., Arolla 10 m., Trient 16 m., Oberaar 31 m., Unteraar 54 m., Rosenlaui 12 m., Upper Grindelwald 12 m., Eiger 3 m., Blümlisalp 6 m., Morteratsch 4 m., Forno 40 m., and Palü 39 metres.

Of the better-known glaciers which have advanced, the amounts were only 4 m., 1 m., and 2 m. respectively for the Ferpècle, Moming, and Lower Grindelwald glaciers.

It is important to note that the average temperature for the quarter July–September, 1933 (most effective in reducing the glacier length) was 1·3° C. above the mean summer average, confirming the view of M. Billwiller that the summer temperature is the principal factor in determining the question of advance or retreat.

The retreat of the Rhone Glacier has caused the disappearance of its beautiful ice-cave, from which issues the infant Rhone. Two lobes were left at the snout, and cryocinemeter measurements were made, at their terminations, of the actual forward and downward movement of the ice, on September 4 and 5, 1933; the amounts were 8 cm. and 13·5 cm.

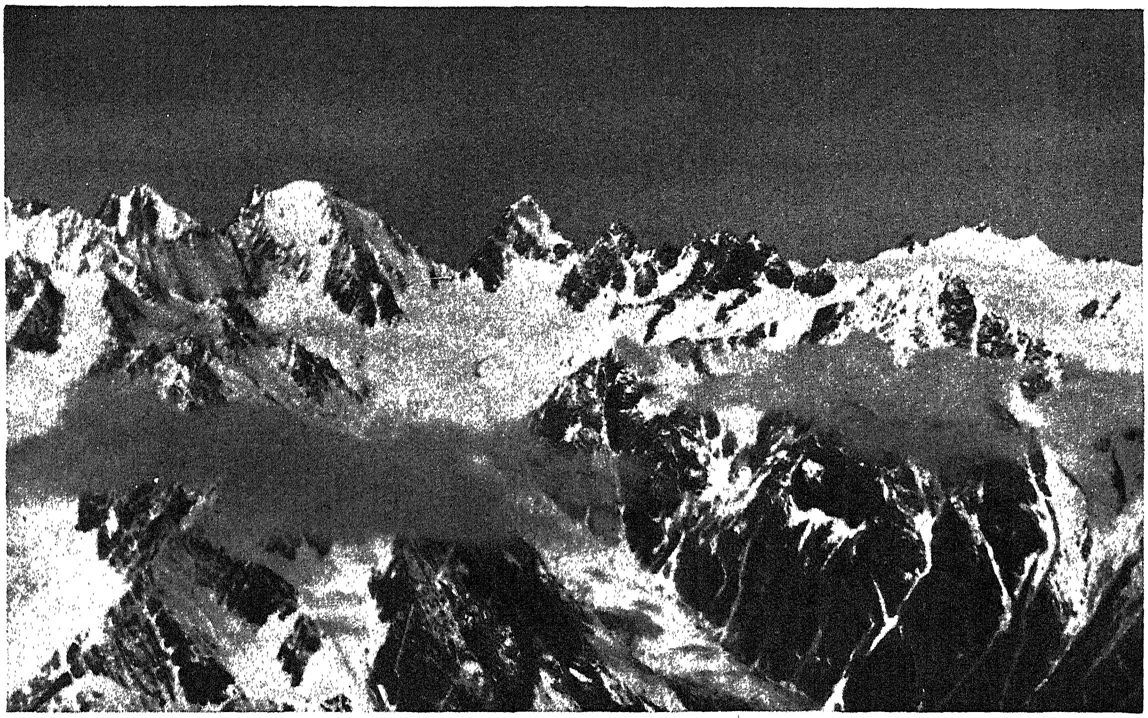


FIG. 1. The Saleinaz, d'Orny, Trient group, Mont Blanc massif, from the air.

a day. In the previous year, similar determinations gave 2·25 and 11·5 cm., so that the actual downward movement of the ice has accelerated, although more of the glacier has melted away, causing the retrogression in position of the glacier end. There is here afforded a good illustration of the clear distinction, that must ever be remembered, between (*a*) the 'advance' or 'retreat' of the position of the snout terminus (determining the length of the glacier), as given in the table, and due to the balance between precipitation and fusion, and (*b*) the ever-persisting downward motion of the ice itself along its natural downward sloping valley, due to the now well-known causes to which ice owes its viscosity and plastic flow, and which is ever being urged by pressure from above.

The outstanding retreat of 54 m. by the Unteraar glacier is largely owing to the enlargement of the Grimsel lake, now three and a half miles long, for the provision of immense electric power stations at Handeck, Boden, and Innertkirchen. The end of the glacier is now formed by ice-cliffs bathed by the waters of the lake, and as this has occurred now for three summers it has resulted in excessive fusion of ice and the breaking away of icebergs, as at the Märjelen See by the side of the Aletsch glacier. The cavernous portal of the Aar has moved backwards 70 m., and during 1933 alone nearly a million cubic metres of ice have disappeared. Fig. 2 shows reproductions of photographs taken in 1933 by Prof. Mercanton, showing the remarkable change which has occurred here.

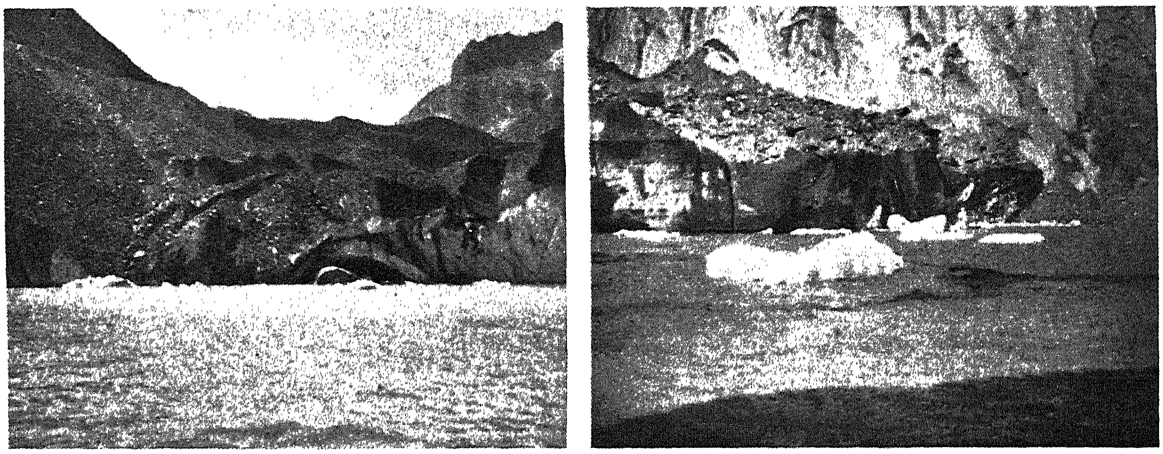


FIG. 2 The Grimsel Lake and Unteraar Glacier.

Turning now to the more important Savoy glaciers, the position of the end of the Glacier du Tour had advanced 356 m. in the year 1920, but it then receded 8 m. in 1921, 45 m. in 1922, 66·67 m. in 1923 and 1924, but only 19 m. in 1925. But in 1926 it advanced again, to the extent of 31 m. Then came fluctuations, a retreat of 33 m. in 1927 and an advance of 14 m. in 1928. After this, in 1929 it receded for 51 m., and again in 1930 still more, for 108 m. In both 1931 and 1932, however, it retreated for no less than 120 m., the maximum observed for ice fusion in the case of this glacier since observations were made by the Department. In 1933 it had slowed down to a retreat of 75 m.

Similar fluctuations have been observed with the Glacier d'Argentière. In 1920 the mass of this glacier had increased so much that opposite the Pavilion de Lognan the ice was flush with the top of the moraine, and there were further advances that year and 1921 of 40 m. In 1922 and 1923 the amount of advance had diminished to only 3 metres; in 1924 it retreated 2 metres, but 1925 brought a slight advance of 6 metres. In 1926 it was distinctly in retreat ($6\frac{3}{4}$ m.), and a particularly beautiful ice-cave was formed at the snout, from which issued the River Arve. The retrogression continued during 1927 (9 m.) and increased to 14 m. in 1928 and 35 m. in 1929, a very fine cavern forming again the portal of the Arve. In 1930 the retreat had diminished to 26 m.; by 1932 it had again increased to 55 m., but in 1933 the retrogression was only 5 m.

The Mer de Glace showed even more remarkable fluctuations of advance and retreat, partly owing to its very awkward gorge of exit. In 1920–21 it retreated 25 m., but in 1923 it advanced 132 m., nearly filling the gorge. In 1924 it advanced a further 47 m., but in 1925 suffered a catastrophic fall and receded 52 m. In 1926 it was again coming forward, and had advanced 95 m. since the preceding July. In 1927 it was curiously stationary. In 1928 and 1929 it advanced 96 m. and 8 m. respectively, since which, from 1930 until 1933, it remained stationary.

The Glacier des Bossons had so increased in the year 1920 as to fill up the ravine to the level of

the moraines, below the lower Châlet, and in the next year it advanced still more. But in June that year a great heat wave commenced, and so much fusion occurred, with disintegration of the snout, that great masses of broken ice were carried away by the people of St. Gervais and Sallanches. With the exception of a slight advance in 1928, much fusion continued to occur up to 1930 ; in 1931 the retrogression occurred for 26 m., but in 1932 for only 8 m. In 1933, however, it retreated no less than 95 m., a fact very evident when I visited it that year. Its twin neighbour, the Glacier de Taconnaz, bifurcating from the Bossons at the celebrated Jonction below the Grande Mulets, receded 22 m. in 1931, and 22 m. again in 1932. The Bionnassay Glacier also showed slight retrogression during 1932 (14 m.). But no measurements were made, for reasons of economy, of either of these glaciers in 1933.

Space forbids detailing the observations on the glaciers of Dauphiny, the Tarantaise, the Isère and the Maurienne, but from the foregoing account concerning the better-known glaciers it will be clear that, on the whole, the glaciers of the main Alpine chains appear to be at present in a period of retreat. The fluctuations, however, have been so great during the last decade and a half, that it is not possible to assign any specific time limits to the period, or assert the occurrence of an alternation of such cycles of advance and retreat of definite duration. What does appear more and more clearly from these researches is that the average summer temperature affects the length of a glacier far more than any other factor, and if this can be shown to vary in clear-cut cycles, then the advance and retreat of glaciers may be found to occur more or less periodically, correspondingly. The figures now available, from more perfect and accurate measurement than has ever before been attempted, certainly do not admit of such broad and sweeping generalisations as have from time to time been put forward.

Boussingault and Agricultural Science

THE year 1934 may well be considered by agricultural chemists as the centenary of the foundation of modern agricultural chemistry. Much work on growing plants had been done before 1834, but it was probably in that year that Boussingault began on a field scale the experiments which led to methods of present-day agricultural science.

Jean Baptiste Boussingault was born in 1802 and took his degree at the School of Mines at St. Etienne. In 1822 he went as a mining engineer to South America, where he spent some years, including six years' service with the armies of Bolivar. During this time, he published several papers on mining and other problems. On his return to France he was elected professor of chemistry in the Faculty of Science at Lyons. In 1833 he married Mdlle. Le Bel and became co-proprietor with his brother-in-law of a farm at Bechelbronn in the Bas-Rhin. It seems more than probable, therefore, that the year 1834 saw the beginnings of the field experiments which he set up in connexion with his work on agricultural chemistry.

De Saussure had, some thirty years previously, grown plants in measured quantities of air and had studied the gaseous exchanges during growth. He had shown that the part played by the soil in plant nutrition was small in amount, but of enormous importance to growth. The constituents of plant ash, he found, varied with the nature of the soil and with the state of development of the plants themselves. His work did not receive the support it deserved, and for long afterwards it was held by many that the carbon in plant tissues was derived from the humus of the soil in which the plants had grown.

Boussingault reintroduced the methods of de Saussure and applied them to crops grown under field conditions. He grew different crops in rotation and measured carefully the amounts of fertiliser added to the plots and the yield of crop obtained. In this way he was able, at the end of the rotation, to draw up an account of the materials taken in by the plant and the amount of mineral material retained in the soil. He found that more dry matter was obtained from the plants grown in a rotation than was given in the fertiliser in the first instance, and that large amounts of carbon and of oxygen must have been obtained from another source—the atmosphere. On the other hand, much less nitrogen was recovered in the crop than had been applied in the fertiliser treatment, and a considerable proportion of nitrogen must have been retained in the soil. He suggested, therefore, that crops should be grown which gave the greatest increase in dry matter over the amount contained originally in the manures. He found, for example, that rotations which included leguminous plants or successive crops of leguminous plants, such as clovers and lucerne, gave a higher nitrogen content in the harvested crop than could be accounted for in the nitrogen given in the manure.

Boussingault pointed out that atmospheric nitrogen could enter directly into the composition

of those plants which were able to fix it, at the same time showing that leguminous plants grown in sterilised soil were no more able to fix nitrogen than were other plants similarly grown. It was left to later workers, however, to supply the clue which led to the discovery that soil bacteria play an important part in the fixation of atmospheric nitrogen. Boussingault opposed the view of Liebig that plants obtained their nitrogen as well as their carbon dioxide directly from the air. With reference to the vexed problem of the nitrogen content of manures, he wrote:

"Si M. Liebig a raison, nous somme, nous autres cultivateurs, de bien gros maladroits: nous nous donnons beaucoup de peine pour conduire, pendant l'hiver, nos fumiers sur nos terres, nos attelages nous coutent cher: si le matière minérale des engrais est seul utile, brulons nos fumiers et, pour le transport, une brouette fera l'affaire".

As time went on, Boussingault expanded his researches to embrace the whole range of agriculture and kindred sciences. His work on the nitrogen metabolism of plants led directly to the protein metabolism of the animals which fed on the crops on one hand and to the carbohydrate metabolism of plants on the other. Much of his later published work deals with the problems of plant and animal physiology in the more restricted sense.

In 1839, Boussingault left Lyons and was appointed to the chair of agricultural and analytical chemistry in Paris, where he remained for many years. He was elected to the Paris Academy of Sciences in the same year. The Council of the Royal Society awarded him the Copley Medal in 1878. For a short term, he represented the Bas-Rhin in the National Assembly, but change of Government led to his being defeated after some three years.

Most of Boussingault's life was devoted to his studies on agricultural chemistry, and he published his collected papers under the title of "Agronomie, chemie agricole et physiologie". Unfortunately, the experiments on the farm at Bechelbronn were discontinued after some years, and although Boussingault lived until 1887, he had long before been compelled to conclude his original field experiments. The lead given by Boussingault was, however, followed by Ludwig, by Lawes and by many other workers, and some nine years after Boussingault had laid out his original experimental plots, Lawes at Rothamsted began the experiments which have become classical in agricultural research.

Boussingault—the father of modern agricultural chemistry—must be judged not only by the immense volume of work which he himself carried out, but also by the amazing effect his application of exact measurement and experimentation to agriculture has had on that science.

Interpretation of Animal Behaviour

NO topic of biological discussion is better able to revive old controversies and established cleavages in opinion than the methodology of animal psychology. It owes this propensity to the fact that the comparative study of behaviour is not, and never has been, integrated into a single consistent science. The subject is so wide, its interests so many and varied, that not only may its methods range from those of physiology to those of systematic 'nature study', but also, as was shown in the discussion on the "Interpretation of Animal Behaviour" which took place in Sections D (Zoology) and J (Psychology) at the recent Aberdeen meeting of the British Association, many of its disciples may prove to be both lacking in knowledge of the interests, and of necessity opposed to the outlook, of investigators engaged in trying to advance the same branch of knowledge along paths different from their own. If it did nothing else, the Aberdeen discussion at least clearly defined for animal psychology the opposition between the vitalistic, teleological and subjective points of view on one hand, and the objective and mechanistic on the other.

The primary objection raised against the mechanistic interpretation of behaviour was that animals are not concatenations of mechanical systems in action, and that accordingly their behaviour can neither be adequately explained in mechanical terms, nor satisfactorily investigated by causal-analytical methods alone (to use the term employed by Dr. E. S. Russell in his presidential address to Section D (Zoology)[1]). In defence of this view, Dr. Bierens de Haan affirmed that an essential characteristic of the behaviour of living things which distinguishes it from that of non-living systems is organised purposiveness or directiveness. Prof. William McDougall penetrated further into teleology, insisting that it is not enough to accept purpose as a general principle; it is essential, he considers, that it be recognised that all animal activity is 'goal-seeking', for in the appreciation of this fact lies true understanding.

Those opposed to mechanism were, however, not content to argue against the causal-analytical investigation of animal behaviour on account of a teleological distinction alone. They also suggested, as Dr. E. S. Russell implied[2], that in any

event mechanistic analysis must be fundamentally unsound if modern physics has had to abandon determinism, and as a further argument in support of this view, Dr. Bierens de Haan protested that the mechanistic analysis of a form of activity gives only a number of parts—for example, reflexes—which in themselves provide no understanding of the behaviour, since the bond linking them in the intact animal is missing. This criticism of scientific method and interpretation, with which Dr. Russell is in sympathy, plainly owes its inspiration to the philosophies of emergent evolution and holism.

Not unexpectedly, these views found little favour with those who advocated the mechanistic approach. An appearance of purpose and adaptation, Dr. S. Zuckerman pointed out, is not a characteristic of the activity of living things only. It is manifested equally well in the inorganic world, the scientific exploration of which is nevertheless conducted without the help of teleological speculation. Moreover, as the same speaker remarked, it is misleading to argue, on the basis of some of the uncertainties of atomic physics and on the strength of the opinions of popular expositors of physical science, that mechanistic determinism is dead. In support of this opinion, we may recall a sentence from a recent leading article in NATURE[3]: "Newtonian mechanics, so far from being in ruins, is more firmly established than ever as the form taken in ordinary circumstances by the mechanics of relativity".

The argument that the parts produced by causal-analytical study are an inadequate interpretation of behaviour—in other words, the argument that the whole is greater than the sum of its parts—was countered, and in what is the obvious way from a scientific point of view, by refuting it as a criticism based both upon a primary misinterpretation of scientific method, and upon a misunderstanding of the province of science. A serious attack was also made on Prof. McDougall's teleological doctrines. Quite apart from other considerations, Dr. Knight pointed out that 'goal-seeking' is as much a characteristic of the behaviour of the roots of a plant as it is of the behaviour of animals.

It is difficult to define precisely what those opposed to the usual experimental methods in the study of behaviour offered in their stead. It was suggested that the principle of organisation and the concept of the functional whole should form guiding lines to investigations of animal behaviour. Exactly how this would alter present methods of investigation was not revealed, for it is plain, as the mechanists argued, that the concept of organisation is an implicit premise in any form of behaviour which an experimentalist sets out to investigate. The most definite suggestion made by the vitalists for the improvement of present experimental methods in comparative psychology was simply a plea to amplify descriptions of animal behaviour with terms derived from introspective human psychology. This proposal was immediately decried by the mechanists, as being a reactionary step which would bring animal psychology back again to its discredited anecdotal phase.

In attempting to judge of the merits of the opposed points of view expressed in Aberdeen, it is well to remember that animal psychology as an experimental laboratory science is a very recent innovation. It is barely forty years since the subject was born out of a mist of anecdote and anthropomorphic description. It was then that Lloyd Morgan made the statement—now revered as 'the canon of Morgan'—that "in no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of one which stands lower in the psychological scale". As a guide to scientific progress, the dictum seems rather inadequate to-day; yet this canon is the only check to the limits which subjective interpretations of animal behaviour may reach, and like all pieces of similar advice, there are no possible limits to the varying complexions it may present to different individuals. Abstract theorising, without fixed standards, brought introspective psychology nowhere as a science. Only by the adoption and application of statistical methods to such of its subject data as were capable of precise definition, has it been in any way prevented from foundering in a torrent of conflicting waves of opinion. *Per se* and in isolation, an interpretation in subjective terms of an act of another organism is not material for scientific treatment; and even less scientific is preoccupation with teleology.

It may well be, as Dr. Bierens de Haan declared, that a purely objective attitude in the study of animal behaviour provides an unsympathetic account of the ways of animals. Be this as it may, one can be certain that its promoters intended the Aberdeen discussion as a statement of how animal behaviour is to be scientifically interpreted, and in the circumstances one cannot doubt that objective analysis alone will provide us with an acceptably expressed and integrated body of knowledge. That, after all, is the business of animal psychology as a science, regardless of the unfounded claims of extreme behaviourists, and in spite of the preoccupation of another school with teleology and other purely philosophical issues.

If the achievement of an exact and organised science of animal behaviour proves slow, let us remember Freud's admonition[4]: ". . . it looks as

though people did not expect from psychology progress in knowledge, but some other kind of satisfaction; every unsolved problem, every acknowledged uncertainty, is turned into a ground of complaint against it". Such an opinion from one whose chief activities have been concerned with the subjective world reflects poorly on those who condemn an objective approach to psychology because the fruits it has yielded are as yet neither rich enough nor abundant enough for their taste.

[1] "The Advancement of Science, 1934". British Association.
[2] *ibid.*
[3] NATURE, **134**, 340, Sept. 8, 1934.
[4] "New Introductory Lecture on Psycho-Analysis".

Obituary

Prof. Karl von Linde

PROF. KARL VON LINDE, who died on November 16 at the age of ninety-two years, was for more than half a century prominent in the refrigeration industry. He was born on June 11, 1842, in Berndorf, and studied at the Erdgenoss Polytechnic, Zurich, where Zeuner taught the theory of machines. In 1868, at twenty-six years of age, Linde became extraordinary professor of mechanical science at the Munich technical college which had just been founded. In 1870 he produced his main paper on "The Extraction of Heat at Low Temperatures through Mechanical Means", in which he proved that none of the refrigerating machines hitherto built had given more than one-fifth of the theoretical capacity. In 1874 he introduced the ammonia refrigerating machine, the first patents on the ammonia compression machine having been taken out by him in 1870. Linde's machine, besides being thermodynamically efficient, was characterised by the excellence of its mechanical design.

In 1891, the Linde British Refrigeration Co. supplied meat freezing plants to New Zealand and Australia, thus participating in laying the foundation of what is now a huge frozen meat industry.

In Germany Linde's patents were exploited by the Lindes Eismaschinen AG. founded at Wiesbaden in 1879. In 1891 he retired from the chairmanship of the company in order to resume his work at the Technical High School, Munich.

Another notable invention of Linde was his air liquefying and oxygen producing apparatus. The apparatus is described in British Specification No. 12528 of 1895, and it comprises an air compressor communicating with a reversed flow heat interchanger having two tubes of different diameters and about 300 ft. long; one tube is inserted in the other so as to leave an annular space and both are coiled helically, the coils being insulated by raw sheep's wool.

The compressed gas, after expansion at the regulating valve, flows back in the annular space to the compressor, whilst after operating for some time a portion is liquefied. In the same patent, Linde described his apparatus for obtaining oxygen from liquid air by fractional evaporation. The products were substantially pure oxygen and nitrogen mixed with a rather large quantity of oxygen. The purer the oxygen the less was the yield. In a subsequent improvement Linde treated the liquid air in a rectifying column and completed the process of separating the oxygen and nitrogen by a fractional evaporation.

After devising the method for the production of liquid air, Linde found an application for the liquid rich in oxygen obtained by the partial evaporation of liquefied air. He showed that when mixed with wood charcoal or other combustible material a powerful explosive was obtained.

Linde's interest in low temperature technology continued throughout his life, and at the age of eighty-three he applied refrigeration to the problem of separating from coke oven gas the constituents hydrogen, methane, carbon monoxide and nitrogen.

Linde was ennobled for his services to science.

E. G.

Mrs. H. S. Williamson

WE regret to record the death on December 4 of Mrs. H. S. Williamson. She was born in 1884, educated at the Royal Holloway College and published her early papers in her maiden name of Chambers from 1908 onwards. She held posts at the Universities of Sheffield and Belfast, and at the Royal Holloway College. In November 1914, she married Ernest Lee, whose work on leaf-fall indicated his great promise; he was killed in action in 1915. In the autumn of that year, she trained for bacteriological work and replaced in the Seamen's Hospital at Greenwich an official proceeding on active service.

In 1920, while employed at the Imperial College of Science and Technology, she married Mr. J. W. Williamson, secretary to the British Scientific Instrument Research Association. In 1926 she accepted the post of research assistant to the professor of botany at Birkbeck College, and was joint author of a series of papers on the fungi.

Mrs. Williamson possessed an unusually fine technique, was a careful and critical observer and, as many can testify, an excellent friend and colleague.

H. C. I. G.-V.

WE regret to announce the following deaths:

Mr. J. A. Brodie, formerly city engineer of Liverpool, president of the Institution of Civil Engineers in 1921, a pioneer in modern methods of road construction, on November 16, aged seventy-six years.

Prof. S. H. Gaiger, professor of veterinary pathology in the University of Liverpool since 1926, and president of the Royal College of Veterinary Surgeons, on December 14, aged fifty years.

Prof. S. P. Mulliken, professor of organic chemistry in the Massachusetts Institute of Technology, on October 24, aged sixty-nine years.

News and Views

Mechanisation in Industry

IN his chairman's address to the Birmingham and District Association of the Institution of Civil Engineers on October 23, Mr. C. H. Bailey, after indicating the way in which scientific research and its applications have enabled the number of explosions of coal dust and firedamp in mines to be controlled more effectively, so that the loss of life in this way has been reduced to about $1\frac{1}{2}$ per cent of what it was thirty years ago, referred to the growth of the professional spirit in the organisation of industry, alike on its financial, commercial and technical side. Already industry is regarded as a public service to a much greater extent than in previous generations. The professional man carries out his work to the best of his ability for the sake of sound workmanship, and the same spirit makes industry interesting and worth while. The special function of a body such as the Institution of Civil Engineers, however, is to provide a standard of professional conduct and ability for those engaged in the technical direction of industry, and such institutions are accordingly closely concerned with those changes in the structure of industry and society which are associated with rationalisation. Mr. Bailey directed special attention to the unification of an industry and the size of the industrial unit, but in doing so he also pointed out its bearing on individuality.

IF democracy means anything, it means a social system which will give free play for individuality, and accordingly free education for all is a first consideration in the minds of the leaders of democracy. If, however, machines can only be used efficiently in large concentrations, there is grave danger that opportunities for the expression of individuality will be severely limited. The real incentive to the best effort is the consciousness of occupying sooner rather than later a position of free responsibility. Engineers are ultimately responsible for the tendencies in industrial organisation and at the same time are the victims of their own machines. The technical side of industry seems to have outrun the financial side, and it may be that the great changes on the technical side demand a reconstruction of the financial framework. The essential problem before us is to fit mechanical manufacture into an organisation which affords more men the opportunity of using their capacities to the fullest extent. Industry should perhaps be organised more in small units in which more men could look forward to occupying positions of real free responsibility, and Mr. Bailey suggested that the Institution of Civil Engineers has a real responsibility to its younger members to see that opportunities of utilising their ability are available from the point of view of the community, as well as of the profession. Industry should be regarded from the point of view of a life as well as of production.

Archæology in Iraq

IT would appear that the way is being paved in Iraq for a drastic revision of the regulations affecting archæological exploration. That at least is the obvious conclusion to be drawn from the campaign of propaganda to which Dr. C. Leonard Woolley refers in his letter to the *Times* of December 12. It has been known for some time that a new Antiquities Law was contemplated. It was indeed this fact, combined with the difficulties arising from the division of the antiquities from Arpachiyah as between the Bagdad Museum and the organisers of the expedition, which led to the closing down of that important excavation at the end of the season of 1933. The character of the agitation against archæological expeditions from outside may be gauged from the statement made to Dr. Woolley personally by the curator of the Bagdad Museum that the archæological finds assigned to that Museum in the division with foreign missions had amounted only to one half of one per cent. Dr. Woolley, by quoting the actual percentage allotted to the Museum year by year, was able to show that the statement was without foundation so far as concerns the division of antiquities from Ur; while his explanation of the principles which had been followed in making the allocation was sufficient to exonerate the Director of Antiquities from any charge of unfair discrimination, due to his being a foreigner, if indeed any defence were needed.

DR. WOOLLEY places his finger on the crux of the situation in Iraq when he points out that, had it not been for the foreign archæological missions, there would have been no museum at Bagdad, or at least the finest collection of antiquities in the Near East would not have come into existence. The exploration of archæological sites in Iraq has hitherto been carried on by museums or bodies for research and higher education, such as the Oriental Institute of the University of Chicago and the recently constituted British School of Archæology in Iraq, bodies which in the ultimate analysis are normally the channels whereby the private individual is able by subscription to further his interest in archæological research, whether general or specific. While ready to recognise the equity of a division of the material results of excavation with the country of origin, these subscribers look to the enrichment of the collections of the museums through which they contribute as the staple return for their outlay. Further restriction of this return will dry up the source of supply. That it has already had this effect is indicated by Dr. Woolley's statement that, whereas eleven expeditions were recently at work in this field, now there are but two. It is deplorable that, while funds can be raised, archæological activity should be diverted from the area which at present provides the most important and the most fruitful of all the fields for archæological research, and at the same time a possibility of solving some of the most insistent problems of prehistory. A logical solution which would maintain Iraq's control of all antiquities discovered would be the institution of an active Archæological Survey service, on the lines of that of India,

powerfully manned and adequately financed for exploration no less efficient than that carried on by foreign missions; but for this clearly the time is not yet ripe.

Suggested Use of Red Filters for Improving Vision

IN the *Klinische Wochenschrift* for November 3, Dr. Arnold Berliner, editor of *Die Naturwissenschaften*, has advocated the use of a red filter for improving vision when the media of the eye are hazy, as from vitreous opacities, incipient cataract, etc., since in such media light of short wave-length is scattered more than that of longer wave-length. The theoretical validity of this physical argument is undoubted, but physiological considerations render it doubtful whether much advantage would accrue. It is interesting to note that somewhat similar improvement of vision has been predicted for a glass of very different transmission characteristics by Dr. Birch-Hirschfeld (*Z. Augenheilkunde*, **77**; 1932) and Dr. Danmeyer (*Hansa Deutsche Schiffarts-Z.*, December 1933). This 'neophan' or 'neodym' glass contains neodymium, and is slightly blue-violet in colour. It will be remembered that Sir William Crookes made and investigated the light transmission of such a glass, which differs little from that of the 'Crookes' glass now on the market, though it apparently has a rather more pronounced absorption band between 550 mμ and 650 mμ. It is held that the diminution of the yellow reduces the dazzling effect upon the retina. Prof. H. Hartridge, however, has given good reasons for thinking that these rays of highest luminosity in the spectrum are those most important for accurate discrimination of the retinal diffusion image with incident white light.

IT might well be expected on physical grounds that monochromatic light would afford the sharpest retinal image, and the observations of Uhthoff and others support this view, provided that the intensity of the light is adequate. The eye, however, is an extremely complex optical instrument, and its physiological properties are such that maximal central discrimination depends not only upon the accuracy of the optical image, but also upon the sensitivity of the neural receiving apparatus. This is profoundly modified by the conditions of adaptation to light, and also by the condition of the surrounding retina. In many cases, central vision is enhanced by moderate illumination of the surrounding field. Hence the normal scattering of light which takes place in the eye may quite possibly be beneficial. Too much optimism should not therefore be indulged in when based only upon theoretical considerations of a purely physical nature.

Eyesight with Yellow Light

THE high luminous efficiency of the sodium vapour electric light makes it probable that it will be more extensively used in the future, if it can be shown to have no deleterious effect on human eyesight. Under the supervision of the Port of New York Authority and the United States Public Health Service, this question has been investigated by Mr. James E. Ives, senior physicist of the Public Health Service, and his conclusions are included in Public Health Report No. 1640. Two groups of clerks, each about a dozen in number, worked four hours a day at their usual tasks, one group in a room illuminated solely by sodium vapour lamps, the other group with the usual gas-filled tungsten lamps. In each case the illumination of the plane of work was 10 foot candles. The eyes of each subject were examined clinically four times during the investigation, which lasted three months. The sodium light was found soft and easy on the eyes, and no permanent effect on the eyes could be detected, nor was there any difference in the amounts of work done by the two groups.

A Scottish Bird Station

SCOTLAND is well placed for intercepting certain movements of birds on migration. The records made by Dr. Eagle Clarke and after him by the late Admiral J. H. Stenhouse at Fair Isle, ably supplemented by the skill and knowledge of the islanders themselves, have made that remote spot between the Shetland and Orkney Islands a name known to all students of bird migration. But Fair Isle is remote and difficult of access, and it must be admitted that it receives the full tide of migration only under peculiar conditions of weather. On the other hand, the Isle of May, situated off the entrance of the Firth of Forth, is not far from centres of population, is easily reached in most kinds of weather, and has been proved, by many annual visits of Miss Baxter and Miss Rintoul, to be a good post of observation. Accordingly a few enthusiastic ornithologists, the Midlothian Ornithological Club, have decided to make the Isle of May a bird station at which regular, and so far as possible continuous, observations of bird movements will be made, partly by field study, partly by trapping and ringing adult birds. The carrying out of the project has been made possible by the permission of the Commissioners of Northern Lights, and every naturalist will wish success to this promising enterprise.

Pioneer Bird Observatories

THE first bird observatory for making day to day records of passing birds and marking migrating species with numbered aluminium rings in the adult stage, where mortality is much less than in the nestling stage, was formed at the beginning of the present century by Prof. Thienemann at Rossitten, East Prussia, followed shortly after by Prof. Rudolf Drost's observatory at Heligoland. In the United States, the first bird-ringing or 'banding' station was established by S. Prentiss Baldwin on a 100-acre farm at Cleveland, Ohio, with a winter branch at Thomasville, Georgia, but the United States Bureau of Animal Biology now maintains two bird observatories, at Berkeley, California, for migration and waterfowl studies, and North Eastham, Massachusetts, for migration, in addition to general observation reserves for birds and mammals. In the British

Isles the first permanent bird observatory and ringing station was established on Skokholm Island, off Pembrokeshire, in 1932, though since 1927 the Oxford University Ornithological Society has maintained a trapping station at Christ Church meadow and in the Museum grounds. In Denmark, Mr. P. Skovgaard has maintained ringing stations near Copenhagen, and in Russia, the Institut Lesnov carries on the work near Leningrad. In France, the Ministry of Agriculture recently commenced bird migration studies at the Institut des Récherches Agronomiques, at Versailles.

Holism in International Affairs

THE *African World* of November 1934 contains full reports of the more important speeches made by General the Right Hon. J. C. Smuts during his visit to Great Britain in October 4–November 15, 1934. These include his installation as Rector of the University of St. Andrews and his impressive address on "Freedom" (see NATURE, Oct. 27, p. 654), his speech in response to the presentation of the freedom of the City of Dundee, in which he pleaded for faith and vision as opposed to the spirit of pessimism and defeatism which is so widely encountered, a speech at Christ's College, Cambridge, on October 21, speeches on African problems, on Jewry, an Armistice Day speech on post-War obligations and his challenging plea for peace at the dinner of the Royal Institute of International Affairs at the Savoy on November 12. In the latter speech he asserted that the way out of our present troubles lay in our steadily increasing sociality, the interweaving of interests, points of view and ideas, in the 'open door' and the removal of barriers and restrictions, in the dominance of large human principles transcending national boundaries and in the recognition that in mankind we are members one of another. The driving power should be the same urge towards integration and co-operation which characterises holism and the creative process in Nature.

Alaskan Archæology

DR. ALEŠ HRDLIČKA has recently returned to Washington, D.C., from his sixth expedition to Alaska, where he has been engaged in investigating the 'archaic' culture of Kodiak Island. The past season is the third consecutive summer he has spent in extensive excavations on the island, and once more his results have added considerably to knowledge of the culture of the people who have inhabited it, without, however, it may be added, obtaining a solution of the ethnological problem. A peculiar feature by which, according to a communication issued by the Smithsonian Institution of Washington, Dr. Hrdlička has been confronted is the occurrence of 'nest-burials', in which a considerable number of individuals of both sexes have been found together, without any of the customary funerary offerings found in the ordinary graves. It has now been ascertained that many of these skeletons have cracked skulls and broken limbs. Dr. Hrdlička, therefore, concludes that this may be taken as evidence of a village massacre, from which a few individuals escaped to return and bury their dead. Considerable progress has been made in uncovering the 'metropolis' site of the island, a once important centre of population situated on a bay. It shows three stages of settlement. The first and second, by far the longest, belong to the unknown people, whose culture was considerably richer than that of their successors. They show slight affinities with the Eskimo, but can scarcely be considered as of the same strain. After them come the Konings, who are practically identical with the Aleuts of to-day. As is now well known, the unknown people were master craftsmen, especially in the making of beautiful stone lamps and ivory carvings. Dr. Hrdlička regards as one of the most important results of this year's excavations, the evidence of differentiation and occupational specialisation as between family households.

Staff Management Association

AT the inaugural meeting of the Staff Management Association on December 5, which was recently formed under the auspices of the Institute of Labour Management, Mr. F. W. Lawe, staff manager of Harrods, Ltd., said that the Association and its parent body cover practically the whole field of personnel work between them. The Institute's work is concerned with the operative employees, the new Association with the administrative and clerical employees. To-day there is a marked tendency to develop special departments for staff management in industry and commerce, though for many years Government and municipal departments have had their 'establishment officers' whose duties cover the same field. The new Association aims at improving the technique of staff management by pooling mutual experience and comparing methods, and by exploring the aid which can be derived from various sciences. The application of these methods, however, will always be an individual art which must be exercised with human understanding and wisdom. The field of staff management lies in the recruitment and engagement of suitable employees; the training of employees for their work; all questions of salaries and promotions; a considerable responsibility for conditions of work including hours; direct charge of all social, educational and welfare work and, finally, sole charge of the responsible duty of dismissal. Slip-shod methods of learning one's life job are still the rule rather than the exception in Great Britain. The old rough and ready apprenticeship method has largely fallen into disuse, but an enormous all-round improvement could be obtained if training for work were taken seriously. It is significant that most great department stores, for example, have a golf-school for customers but very few have a work-school for their staff.

Electrical Accidents in 1933

THE review of the accidents and dangerous occurrences in Great Britain which took place during 1933 ("Electrical Accidents", 1933. London: H.M. Stationery Office. 6*d*.) is instructive.

Considering that during the ten years 1923–32 the supply of electricity increased nearly 2½ times and that the number of factories under the Electricity Regulations increased about sixty per cent, it is satisfactory to notice that the number of accidents has remained practically stationary during this period. The total number of accidents reported last year was 346, and of these 25 were fatal accidents. These were accidents reportable under the Factory Acts, but the total number of fatal accidents due to electricity was 91. It is gratifying to notice that there has been a marked increase in the use of small transformers to provide a very low pressure for work in places such as the inside of boilers or in tanks or wet spots where electric shock is likely to be unusually dangerous. The accidents due to electric ignition of inflammable materials include cases where obvious risks are taken. In garages, for example, petrol ignition not infrequently results from a spark at the car equipment or from dropping a hand lamp. It is very inadvisable to use such a dangerous cleaning agent as petrol in a garage. Some difficult problems have arisen in connexion with the development of high-frequency furnaces for melting steel. Up to the present, these furnaces have been of small capacity. Molten steel is now sometimes transferred to large high-frequency furnaces where the final stage of refining is done. In this case special precautions have to be taken.

High-Voltage Alternators

THE time always comes when some type of machinery reaches the limit of its possible development, and if progress is to continue it must be along quite different lines. The physical properties of the materials at his disposal and the laws of Nature fix limits to the designer's progress in every direction. For example, the reciprocating steam engine, after a century of development, reached its limit with an output of about 10,000 horse-power. Then came Parsons's turbine principle, and the piston engine soon became obsolete in electric power stations. In the *Monthly Transactions* of the Junior Institution of Engineers of October, Mr. J. Rosen, of Messrs. C. A. Parsons and Co., Ltd., Newcastle, describes a similar change that is taking place in high-voltage production. Sir Charles Parsons and his colleagues in 1921 invented a new type of generator which permitted the generating voltage to be multiplied several times without submitting the insulation to any greater stresses than those in common use in standard machines. Six years ago a turbo-alternator of 25,000 kilowatt power working at a pressure of 34 kilovolts was installed in the Brimsdown Station of the North Metropolitan Electricity Supply Co. and has now been in uninterrupted service for six years. It has been the precursor of many others. The new construction consists of using triple concentric conductors instead of the usual three separate conductors in the stationary armature. The new machines obviate the necessity of using expensive transformers to raise the pressure and thus considerable economies are effected. Mr. Rosen thinks that the new improvements being developed in the composition of insulating materials will lead to the use of much higher voltages in the immediate future.

Magnetic Survey of Poland

THE first magnetic survey of Poland is described in *Travaux de l'Observatoire Magnétique de Świder*, No. 5, Warsaw, 1933. The survey is the work mainly of Stanislaw Kalinowski, who in 1905 conceived the ambition that Poland, then dismembered, should be surveyed by Poles, as a national contribution to science. With some help from his compatriots in buying instruments and in providing transport, he made a number of observations before the War; feeling that a magnetic observatory in Poland was necessary as a base for the survey, he succeeded in collecting funds for this purpose from private donors, and the observatory was established at Świder, near Warsaw, just when the War started. During the War the instruments were safely stored, and the buildings fortunately remained unscathed until the Armistice, and through the subsequent war between Poland and Soviet Russia, when Świder was for some days occupied by the Russians. The observatory, with the aid of State subsidies, has functioned regularly since 1921, though as yet funds have not sufficed for the publication of the detailed records. In 1923 Prof. Kalinowski, whose services to the observatory have throughout been honorary, recommenced his magnetic survey of Poland, with financial aid from the Ministry of Public Instruction. From 1923 until 1929 the number of stations at which complete observations of declination, dip and horizontal force had been made was 375, some of which had been surveyed two or more times. The epoch to which the data were reduced was 1928.5. The report of the survey gives the history of the work, and a brief description of the stations, in 56 pages, and the observations themselves in 94 pages of tables. The results are represented graphically on three isomagnetic maps.

East Malling Research Station

THE East Malling Research Station, supported by the Kent Incorporated Society for Promoting Experiments in Horticulture, recently celebrated its coming of age. The annual report for 1933, the twenty-first year, contains a number of reports of practical and scientific investigation, on which the promoters, and especially the director (Mr. R. G. Hatton) and his staff, deserve congratulation. The report is in four parts, namely, (1) experimental farm, (2) general review of research work, (3) preliminary research reports, and (4) bulletins for fruit-growers. The section on the experimental farm is by Messrs. R. G. Hatton, J. Amos, F. H. Beard, M. H. Moore and A. C. Painter, and deals with the general management of the farm, new plantings, cultural treatment, marketing and spraying. The debut of East Malling as a research station centred round Mr. Hatton's classical study of clonal rootstocks for the propagation of fruit trees, so it is natural that much of the research work reviewed in Section 2

should relate to this subject. There are also investigations in root development, biennial bearing, double grafting, non-setting of blossom, pruning, thinning, manuring, variety trials, fruit breeding, and many other problems. Extensive research in plant physiology, biochemistry, plant pathology and entomology is carried out in relation to the outdoor investigations. A noticeable feature of the preliminary research reports is the evidence of strong correlation between all branches of the research station. The influence of stock on scion, for example, is being investigated from different angles by the pomologists, the physiologists and the biochemists. Section 4 is a collection of articles which are intended to portray the results of the Station's scientific work in such a way that they may be used by practical fruit-growers. This is a very necessary activity of any research institution, and it is gratifying to note its increasing volume from year to year in East Malling's annual reports.

Hannah Dairy Research Institute

THE fifth annual report of the Hannah Dairy Research Institute describes the work being carried out at Kirkhill, Ayr, and its commercial and practical applications. The chairman of the Council of the Institute is Sir Robert S. Rait, principal of the University of Glasgow, who succeeded the late Sir Donald MacAlister. The work of the Institute has received increasingly wide recognition as shown by the requests received for its publications from all over the world. At home, the advice of the Institute is frequently sought in solving various practical dairying problems. Work has been carried out on the relative nutritive value of different proteins for milk production, on methods of eradication of bovine tuberculosis and the means by which the risk of milk-borne disease can be reduced to negligible proportions, and on the production of condensed and evaporated milks and canned cream. It is of interest to note that the basis of the Institute's experimental eradication scheme of bovine tuberculosis, namely, the provision of free tuberculin-testing and free advice to owners of dairy herds, has been recommended by the Committee on Cattle Diseases, Economic Advisory Council. The results of the experimental scheme have clearly demonstrated the feasibility of effecting a marked reduction in the incidence of tuberculosis amongst dairy cattle. The Institute appeals for funds to wipe out the present indebtedness and to provide an endowment fund which will produce an income of £2,000 a year.

Research on Preservation of Wood

VOL. 4 of the *Journal of the British Wood Preserving Association* has recently appeared (Printed for the Association, 166, Piccadilly, London, W.1. 1934). Sir John Stirling Maxwell has been re-elected chairman. The work of the Association has been maintained at the high standard set when it was founded, and the *Journal* records a number of interesting papers and discussions during the year dealt with. In view of the fact that bungalows and houses constructed entirely of Empire timbers are now to be seen under construction in Great Britain, Mr. O'Hea's paper on timber buildings proved of considerable interest. Mr. O'Hea dealt with the three distinctive types of timber buildings in the three main parts of the world where they are commonplace, namely, the North American continent, Scandinavia and Russia, and then discussed the timber building in England. Other papers dealt with wood preservation in the service of the Post Office, the use of treated timber in railway stock construction and an excellent paper on the research institutes and forest products laboratories in which work on the preservation of timber is being carried out.

Mining in South Australia

WE have received from the South Australian Department of Mines a review of mining in that country for the half year ending December 31, 1933 (Adelaide: Government Printer, 1934). There is little of permanent interest about this review, but it states that the various Mining Acts have now been consolidated, a new Act to regulate mining on private lands has been passed, and further that copies of the regulations under the Mining Acts were gazetted on March 22, 1934, and can be obtained from the Department of Mines; although the publication under review has condensed some of the more important regulations, those interested are advised to refer to the full text of the regulations. It is stated that the most interesting development is the increase in the production of gold, which is more than double that of 1932, this increased output being of the greater importance on account of the greatly increased value of the gold produced. It appears from the statistics that the total value of mineral produced in 1933 shows a marked increase over the production for 1932.

Greenkeeping Research

THE Board of Greenkeeping Research has recently issued its Report for 1933. Most of the Board's activities are centred round its Research Station at St. Ives, Bingley, Yorks, where experiments on the qualities of various lawn grasses are in progress. During 1933, plots of *Poa annua*, *Agrostis*, and *Festuca rubra* have received special investigation in order to determine their suitability for golf green purposes. Manurial experiments have been correlated with yield data. Various compounds are being tried as worm eradicators, whilst the success of the St. Ives leather jacket exterminator (a standardised emulsion of Jeyes' fluid and orthodichlorobenzene) must be very gratifying to its originators. The establishment of greens by means of vegetative propagation is receiving considerable attention, and the aeration of turf is a subject for further experiment. Advisory work is growing, and the financial statement shows a small surplus. Attention is directed to the *Journal* of the Board, which is published twice a year and may be obtained from the Station.

Our Nearest Neighbour

WHEN the star Proxima Centauri was discovered by Innes to have a parallax of 0·88″, he realised that

this value implied that it is the closest star to the solar system, and gave the star its present name. The nearest competitor is α Centauri, which has a parallax of $0\cdot76''$. Subsequent measurements, however, have failed to confirm Innes' value of the parallax of Proxima, and in Schlesinger's Catalogue a weighted mean value of $0\cdot802''\pm0\cdot050''$ is given. This still makes Proxima nearer to us than α Centauri; but the parallax has recently been determined both at the Yale Observatory at Johannesburg and at the Royal Observatory at the Cape of Good Hope, the results being $0\cdot783''$ and $0\cdot758''$ respectively. The name given to Proxima is accordingly seen to be in grave danger of losing its justification, and it appears possible that α Centauri is after all the closest neighbour of the solar system in space.

Fireball of October 11, 1934

AT 10 h. 29 m. p.m. of October 11 a very brilliant meteor appeared over eastern Yorkshire. Mr. A. King, 53 Victoria Road, Ashby, Scunthorpe, Lincolnshire, received nineteen observations, ranging in place from Durham in the north to Chipping Campden in the south-west and Brentwood in the south-east. The total light of the fireball, in Yorkshire and north Lincolnshire, was probably greater than that of the full moon. From the best observations, the following real path is found: Began, 94 miles over 3 miles E.S.E. of East Malton, Yorks.; mean deviation 2·0 miles. Ended, 50·8 miles over 5 miles N.E. of Brigg, Lincs; mean deviation, 0·8 mile. Earth-point, near Boston. Length of visible track, 58 miles; speed, 21 m.p.sec. Radiant, α, 252·3°; δ, + 75·8°, in Ursa Minor. The speed, allowing for air resistance, was of the parabolic order; hence, corrections for zenith attraction and diurnal aberration were applied to the observed radiant, and an orbit computed, on the assumption of parabolic velocity. The corrected radiant was 249·6° + 74·9°, and the orbit: ι, 56·3°; π, 15·6°; Ω, 197·9°; q, 0·998. The meteor left a streak along its track, extending from 77 miles high to 56 miles over 2 miles S.S.E. of Barton-on-Humber. The upper portion quickly vanished, and the part from 69 miles over $4\frac{3}{4}$ miles N.E. of South Cave, Yorks, to end as given above (mean deviations, from three observations, respectively 1·8 m. and 1·9 m.), drifted in an east-north-east direction, taking up, in 3 minutes, a position extending in a curved line from 73 miles (dev. 2·0 m.) over $3\frac{1}{2}$ miles, roughly east of Beverley, to 58 miles (dev. 3·0 m.) over West Hull, the forward point of the bend (one third way from the lower end) being above 1 mile N.W. of Sutton, Hull; height, 64 miles (dev. 3·4 m.). The corresponding rates of drift were thus 168, 156 and 186 miles per hour.

Grants for Metallurgical Research

THE Council of the Iron and Steel Institute awards annually a limited number of grants, each not exceeding £100, from the Andrew Carnegie Research Fund for metallurgical research work. The object of the scheme is to enable students of academic or industrial experience to conduct researches on problems of practical and scientific importance relating to the metallurgy of iron and steel and allied subjects. Candidates, who must be less than thirty-five years of age, must apply before the end of next January on a special form to be obtained from the Secretary of the Institute.

Aviation and Public Health

THE Third International Congress of Sanitary Aviation will be held at Brussels on June 11–17 at the time of the Universal International Exhibition. The subjects for discussion at the Congress, which has been organised by the Aero-Club of Belgium, of which Dr. Charles Sillevaerts is president, are as follows: utilisation of private and commercial aeroplanes for sanitary objects; collaboration of public services and private organisations for the utilisation of sanitary aviation in peace time; organisation and working of first aid in public aerial transport; and help afforded by aviation in times of calamity. Moscow, Leningrad, Kiev, Odessa, Kharkov, Minsk, Baku, Sverdlovsk, Irkutsk and Khabarovsk have recently been provided with aeroplanes intended to convey first aid to patients in out of the way districts which have no doctors or have been rendered inaccessible by floods, storms and the like. The aeroplanes can be summoned by wireless, telegraph or telephone.

Leipzig International Industries Fair

THE Leipzig Spring Fair 1935 will be open on March 3–10. The Samples Fair closes at noon on March 9, but the Engineering and Building Fair will be open until March 10. The Textile Fair closes on the evening of March 6. The "Bugra" (Book Trades) Machine Fair closes at noon on March 9. The section representing the optical, photographic and cinema industries, which has hitherto been housed in the Gymnasium at the Frankfurter Tor, is being included in the Engineering and Building Fair, and its exhibits will be arranged in Hall 12 (Dome Hall). This will make the Leipzig Fair more self-contained, a fact which should be appreciated. It is announced that the Machine Tool Hall (Hall 9) has been booked up completely, and further exhibits have overflowed into Hall 11. In the Electrotechnical Hall, too, all space available has been booked. General mechanical engineering will be well represented, there being large increases in the department of Diesel engines and foundry machinery. Manufacturers of gas appliances are arranging a special exhibition on a large scale in the Building Trades Hall.

National Academy of Medicine in Spain

THE second centenary of the foundation of the National Academy of Medicine was celebrated at Madrid on December 10 by an exhibition of books and documents dating from the fifteenth century, including treatises on plague and bloodletting and commentaries on Hippocrates, and by an address on the history of the Academy by the librarian, Dr. Goyanes.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1011.

Modes of Stimulation of the Gastric Secretion

THE manner in which gastric secretion is stimulated through the parasympathetic nervous system and by histamine may be better understood by means of combined physiological and histological study.

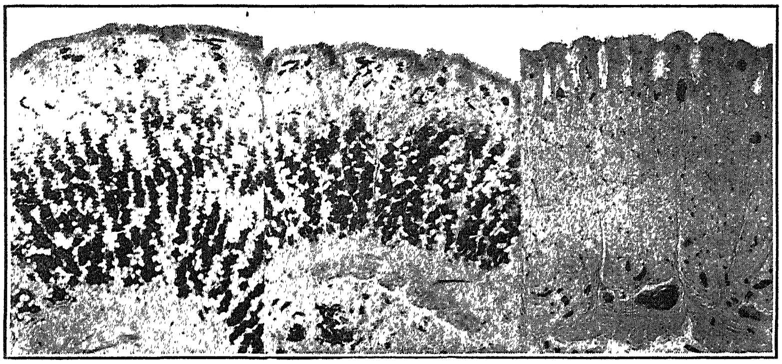
Rhythmic stimulation of the vagi with a weak induction current produces a scanty flow of slightly alkaline, neutral or slightly acid mucous fluid from the stomach. A stronger current provokes a copious secretion of regular gastric juice of high acidity and peptic power and rich in dissolved mucin[1]. If there are in the vagus two kinds of secretory fibres innervating the gastric mucosa, then those which are activated by a weak induction current will have relation chiefly to the surface epithelium cells and perhaps to the mucoid cells. In strong stimulation of the vagi, mucoid, peptic and parietal cells are brought into activity. Under normal conditions, when gastric secretion is produced, for example, reflexly as in 'sham-feeding', the composition of the juice corresponds to that obtained by strong electrical stimulation of the vagi. However, at the end of the secretory period there is an abundant flow of visible mucus, which is much greater than in gastric secretion stimulated by histamine or alcohol[2, 3]. This suggests the participation of surface epithelium mucous cells in certain phases of reflexly provoked gastric secretion.

The exceptionally high peptic power of 'vagus' gastric juice may be attributed to an enormous discharge of granules from the peptic cells, the granules being presumably vehicles of the enzymes[4]. (Compare Fig. 1(*a*)—control—with Fig. 1(*c*)—effect of vagus stimulation—and note the disappearance of the dark-coloured granules from the peptic cells.)

Quite different relations were noted when histamine was administered to an animal. The volume of secretion produced by this drug is no less and sometimes even greater than in experiments involving electrical vagus stimulation or sham-feeding. The acidity of the 'histamine' gastric juice and its total chlorine concentration correspond to those of the 'vagus' juice. This shows that the source of almost all the chlorine is in both cases one and the same[5]. On the other hand, the total organic matter, including the pepsin and dissolved mucin, gradually diminish during secretion. They may practically disappear from the juice if histamine is injected repeatedly[6, 7, 8]. Therefore it seems legitimate to conclude that histamine stimulates the parietal cells only, producing a flow of acid solution, without having any effect on the peptic cells (Fig. 1(*b*))[4]. At the beginning of the secretion on histamine, the acid solution produced by the parietal cells washes out from the glandular tubules the zymogen material which may have accumulated there, presumably during the inactivity of the gland.

Histamine action on the gastric glands is not, however, restricted to selective stimulation of the parietal cells. Experiments in which gastric secretion activated by histamine was followed by sham-feeding or a test-meal showed that histamine definitely diminishes the secretory effect of the two latter agents[9]. Histamine exercises its greatest inhibition on the nervous, that is, 'vagal', phase of gastric secretion.

These and other experiments support the theory that many of the digestive glands are composed of different sets of secretory epithelia. The secretory activity of such glands is not regulated *en masse*, but various nerves (for example, those innervating the submaxillary gland[10]) or chemical agents stimulate or inhibit each set of secretory elements separately. This does not exclude the mutual influence of one group of cells on another through the action of 'chemical messengers'[11, 12]. Therefore it may be concluded that the *qualitative* changes which occur in many digestive secretions under various conditions of stimulation are due to the unequal *quantitative* activity of different groups of secretory cells in a given gland[13, 14, 15].



(*a*) (*b*) (*c*)

FIG. 1. Sections of gastric mucosa. (*a*) Control; (*b*) effect of histamine stimulation; (*c*) effect of vagus stimulation.

The histological part of the investigations quoted in this letter was performed in the Department of Histology, McGill University, under the direction of Prof. J. C. Simpson.

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Oct. 27.

[1] Vineberg, *Amer. J. Physiol.*, **96**, 363; 1931.
[2] Webster, *Amer. J. Physiol.*, **90**, 718; 1929.
[3] Webster, *Trans. Roy. Soc. Canada*, **25**, Section V, 213; 1931.
[4] Bowie and Vineberg (in preparation).
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[15] Babkin, *Canad. Med. Assoc. J.*, **25**, 134; 1931.

Magnitude of Cosmic Ray Bursts

IN a paper which I had the privilege of presenting for them at the recent London Congress of Nuclear Physics, R. D. Bennett, G. S. Brown and H. A. Rahmel described some very large cosmic ray bursts, which they recorded using a large argon-filled ionisation chamber stationed on Mount Evans. In six of these bursts the number of ion pairs suddenly appearing within the chamber was greater than 3×10^8. The largest one threw the electrometer off scale, which meant more than $6 \cdot 25 \times 10^8$ ion pairs. It is of interest to estimate the total energy involved in such a process.

Using Gärtner's value[1] of 29·6 electron volts per ion pair in argon, the energy required to produce the ions caught within the chamber exceeds $1 \cdot 85 \times 10^{10}$ e.v. Experiments performed by E. O. Wollan using different pressures of argon in our recording chamber show, however, that the magnitude of the bursts is at least roughly proportional to the pressure. This means that up to the highest pressure employed (50 atmospheres) only a small fraction of the ionising radiation from the burst is absorbed in the argon. We may thus assign as a lower limit to the total energy about four times that which is actually measured.

If we suppose that a burst is merely a large shower, and if we use the interpretation of shower production presented by P. M. S. Blackett and others at the Congress, intense ionisation such as occurs in the bursts should extend throughout the whole region traversed by the shower-producing radiation (photons ?) excited by the impact of the cosmic ray particle upon an atomic nucleus. If the region within which this radiation is absorbed is homogeneous, the fraction of its energy spent within a region of small thickness δx is approximately

$$F = \mu e^{-\mu x}\,\delta x, \qquad (1)$$

where μ is the absorption coefficient of the radiation in the medium. If, however, the burst originates in a medium a (the steel walls of the chamber) and spreads through a cavity of thickness δx filled with medium b (argon gas) which absorbs only a small fraction of either the photon radiation or the secondary beta rays which they excite, the fraction of the energy spent within medium b is

$$F = \mu\frac{\mu_b}{\mu_a}e^{-\mu x}\delta x, \qquad (2)$$

where μ_a and μ_b are respectively the effective absorption coefficients of the secondary beta rays in the two media. Measurements on the transition effect indicate that μ for the shower-producing radiation in iron is about $0 \cdot 13$ cm.$^{-1}$. The absorption of the high-speed β-rays is found to be nearly proportional to the density, that is:

$$\mu_b/\mu_a = \rho_{\text{argon}}/\rho_{\text{iron}} = 0 \cdot 0106.$$

For the largest bursts we may take $e^{-\mu x} = 1$. Thus from equation (2) we get $F = 0 \cdot 033$ as the fraction of the total energy absorbed within the ionisation chamber. This corresponds to a total energy of about 6×10^{11} electron volts for the largest recorded burst.

Several considerations must increase somewhat this estimate of the energy: (1) The number of ions produced in the chamber was greater than $6 \cdot 25 \times 10^8$. (2) It is impossible that all of the secondary shower-producing rays can have passed through the chamber, though most of them may have done so. (3) A part of the shower-producing rays will probably have been absorbed before reaching the chamber. The total energy of the largest burst must thus have been between 10^{11} and 10^{12} electron volts, and probably nearer the latter value.

These energies correspond to the masses of atoms of atomic weight 100–1,000. They are thus too great to arise from any kind of nuclear process, unless it be the improbable one of a nuclear chain reaction within the instrument, and involving many atoms. The apparent absence of any possible mechanism whereby such a chain reaction might be effected seems sufficient to rule out this suggestion.

It is noteworthy, however, that in order to penetrate to 600 m. of water, where cosmic rays are still perceptible, according to recent calculations of Bethe a proton must have an energy of the order of 2×10^{11} electron volts, and an electron greater energy, while no photon should reach such a depth. It would thus appear probable that cosmic rays occur with sufficient energy to produce directly all the ionisation observed in these bursts.

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[1] O. Gärtner, *Ann. Phys.*, **2**, 94 ; 1929.

Heavy Water in the Animal Body

IN NATURE of December 8, p. 879, Hevesy and Hofer report an experiment in which they study the rate of elimination of a quantity of heavy water ingested (in man). They found that half the quantity was excreted in the urine 9 (± 1) days after the ingestion. From this they calculated that "the average time a water molecule spends in the body is 13 ± 1·5 days", and assume "that most of the water taken becomes completely mixed with the water content of the body".

Some time ago, we made an experiment on the absorption of heavy water from the small intestine of the rat. We had already made the following calculations, and now bring them forward in support of Hevesy and Hofer's view.

A 4·5 per cent xylose solution, that is, a solution isotonic with the blood, was made in a 1·66 per cent solution of heavy water in ordinary water. By the exchange of four OH groups, the heavy water had now a concentration of 1·64 per cent. 6 c.c. and 4 c.c. respectively of this solution were injected into 60 cm. jejunal loops of two anæsthetised rats, which had fasted for 20 hours. After one hour the animals were killed, and the contents of the loops taken for analysis. We know from previous experience that in such experiments the quantity of fluid remains about the same, while about one fifth of the xylose is absorbed, and sufficient sodium chloride diffuses in to keep the solution about isotonic with the blood.

The heavy water content of the intestinal fluid was then analysed, after thorough purification and repeated acid and alkaline distillation. It was found to be 0·07 per cent in the first case, and 0·05 per cent in the second. This shows that there is a very rapid exchange of water injected (with its indicator

of heavy water) with the water of the whole body, independent of the change in the concentration of the dissolved substance. There was no loss of water during the hour by excretion of urine (not counting the urine in the bladder), and the amount of water expired in such a period is negligible. The supposition that a complete distribution of the injected water has occurred, that is, that the concentration of 0·07 per cent, or 0·05 per cent, is the same throughout the whole body, can therefore be controlled by calculating the quantity of water required to give these dilutions, and comparing it with the total body fluid as calculated from the body weight of the animals. The amounts of water required to dilute 6 c.c. of 1·64 per cent heavy water to 0·07 per cent, and 4 c.c. of 1·64 per cent to 0·05 per cent, are 135 c.c. and 127 c.c. respectively. The body weight of each rat was 200 gm.; taking the water content of the body to be 66 per cent of the weight, we calculate that these rats contained 132 gm. of water each. It is, therefore, clear that the water injected, with its heavy water indicator, has distributed itself throughout the entire body in one hour.

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Linkage of Chemical Changes in Muscle

We have found recently[1] that addition of phosphoglyceric acid to frog's muscle pulp, poisoned with iodoacetic acid, stops the formation of ammonia which is released by this poison; and we have explained this effect of phosphoglycerate, and a similar action of pyruvic salts in fluoride poisoned muscle, by the hypothesis that the resynthesis of adenosinetriphosphoric acid—which cannot be deaminated directly in muscle—is kept going, in absence of glycogenolysis, by the transport of phosphate groups to adenylic acid from phosphoglyceric acid, or from a related phosphate carrier. This transport we have supposed to be indirect; from the intermediary product of glycogenolysis, the phosphate group being transported to creatine, with formation of phosphocreatine, from which it is transported, in Lohmann's reaction, to adenylic acid as phosphate acceptor. The supposed intermediary reaction of the intermediary phosphorus compound with creatine we have written in our scheme of glycogenolysis[2] as reaction (3).

We have now been able to obtain evidence that phosphocreatine is formed readily in muscle pulp poisoned with iodoacetic acid, when phosphoglyceric acid is present: this phosphate carrier is converted into pyruvic acid. The resynthesis of phosphocreatine out of creatine cannot be produced, in such poisoned muscle, either by free phosphate, or by any intermediary product of glycogenolysis: for example, glyceraldehydphosphoric ester, phosphoglycerol, Harden-Young ester, pyruvic acid, lactic acid, diphosphoglyceric acid. Reaction (3) in our scheme may be written as follows:

$$\underset{\text{phosphoglyceric acid}}{C_3H_5O_4\,(PO_3H_2)} + \underset{\text{creatine}}{C_4H_9N_3O_2} = \underset{\text{pyruvic acid}}{CH_3CO.COOH} + \underset{\text{phosphocreatine}}{C_4H_8N_3O_2\,(PO_3H_2)} + H_2O.$$

The intermediary phosphate carrier is probably phosphopyruvic acid, recently discovered in muscle by Lohmann and Meyerhof[3].

As in iodoacetate poisoned muscle pulp phosphoglyceric acid is readily transformed into pyruvic acid, but no pyruvic acid is formed from other intermediary products of glycogenolysis more proximate than phosphoglyceric acid, the point at which iodoacetate interrupts the sequency of glycolysis must be situated above the formation of phosphoglyceric acid, and *not below*, as G. Embden[4] and O. Meyerhof[5] have supposed. Their statement that the oxido-reduction between pyruvic acid and phosphoglycerol does not occur in the presence of iodoacetate, is doubtless correct: but glycogenolysis does not proceed to the formation of phosphoglyceric acid, still less of pyruvic acid.

In the presence simultaneously of pyruvic acid and free phosphates, the formation of ammonia is stopped, and the resynthesis of adenosinetriphosphoric acid is kept going in fluoride poisoned muscle pulp; but when no phosphates have been added—those present in the tissue being converted to esters at the onset of crushing—pyruvic acid has no effect; neither on ammonia formation, which is proceeding rapidly, nor in preventing the splitting of adenosinetriphosphoric acid. A carrier of phosphate groups, transporting these groups to creatine and in this way to adenylic acid is formed, therefore, from pyruvic acid and phosphate—possibly the same as is produced from phosphoglyceric acid.

Pyruvic acid is an intermediary product of anaerobic glycogenolysis, and of lactic acid oxidation in aerobic recovery. As a phosphate carrier specific for the phosphorylation of creatine and adenylic acid can be produced from pyruvic acid and inorganic phosphate, it becomes clear that the same intermediary phosphate carrier may act in the anaerobic and oxibiotic recovery of muscle, leading in both changes to the resynthesis of phosphocreatine and adenosinetriphosphoric acid.

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[1] *Biochem. Z.*, **64**, 272; 1934.
[2] Nature, **134**, 627, Oct. 20, 1934.
[3] *Biochem. Z.*, **60**, 273; 1934.
[4] Not published, read in Basel, May 1933.
[5] Nature, **132**, 337 (v.p. 340), Sept. 2, 1933.

Non-Identity of Vitamin B_2 and Flavines

During the past two years, we have been working on the isolation of vitamin B_2, using the chick for assay work. Only those fractions which had the power of preventing pellagra and allowing normal growth in chicks on the vitamin B_2 low ration described by Kline, Keenan, Elvehjem and Hart[1] were considered to be potent in vitamin B_2. All our results point to the fact that vitamin B_2 and flavines are not identical.

The flavine or the lumiflavine prepared from a liver extract did not protect chicks from pellagra. The animals receiving the flavine showed more severe symptoms of pellagra than those on the basal ration. The liver extract fraction remaining after the flavines had been removed by adsorption on fuller's earth

was highly active in the prevention of pellagra. When the fraction was purified and concentrated, the concentrate was practically colourless, but the vitamin B_2 activity was retained. The flavine was removed from another fraction by irradiation and extraction of the lumiflavine with chloroform. The remaining solution was again active.

A complete survey of the literature has been made and we find no decisive evidence which would prevent us from concluding that vitamin B_2 and flavines are two separate and distinct chemical entities. We wish to retain the term vitamin B_2 for the antipellagric factor, and suggest a reclassification of the flavines.

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[1] Kline, O. L., Keenan, J. A., Elvehjem, C. A., and Hart, E. B., *J. Biol. Chem.*, **99**, 295; 1932.

Production of Ethylene by Some Ripening Fruits

IT was observed by Elmer[1] in 1931 that the presence of ripe apples and pears—but not oranges or bananas—caused abnormalities in the sprouting of potato tubers; and Huelin[2] pointed out that the effects were similar to those produced in potato sprouts by exposure to ethylene. Later, Smith and the writer[3] showed that the growth of pea seedlings was affected by an active substance produced by ripe apples, again with results which were paralleled by ethylene.

Kidd and West[4] had previously noted that a substance produced by ripe apples would stimulate the so-called 'climacteric' in unripe apples; and the writer had shown[5] that an active substance generated in traces by ripe bananas has corresponding effects on the rate of respiration and the ripening of green bananas and on the growth of pea seedlings. In each case, similar results could be produced by exposure to a trace of ethylene.

Analogies between the biological behaviour of ethylene and the active substance, particularly in relation to the epinasty of leaves, have been accumulated in more recent work by the writer[6]; but the purpose of the present note is to record chemical identification of the active substance.

An air-stream containing the whole of the gaseous products of metabolism from some 60 lb. of Worcester Pearmain apples was led, during a period of 4 weeks, through Newth collecting tubes containing bromine at $-65°$ C. 0·85 gm. of oil was obtained, which on fractional distillation yielded 0·65 gm. boiling below 140° C. Heated with aniline this gave a solid which crystallised from dilute alcohol as lustrous plates, melting at 62·5° C. A mixture, with a prepared sample of *N. N′* diphenyl ethylene diamine (melting point 62·5° C.) also melted at 62·5° C.

The particular interest of this identification lies in the definite linking together of two lines of research in the metabolism of fruits—the well-established effects of ethylene on ripening, and the relations between one fruit and its neighbours which were brought to light by Kidd and West.

The amount of ethylene produced is very small—perhaps of the order of 1 cubic centimetre during the whole life-history of the fruit[6]; and the cause of its prodigious biological activity in such small concentrations is a problem for further research. Its production by apples ceases or is very much reduced in the absence of oxygen. Further experiments are in progress.

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[1] Elmer, O. H., *Science*, **75**, 193; 1932.
[2] Huelin, F. E., Report of the Food Investigation Board for 1932, p. 53. H.M. Stationery Office.
[3] Smith, A. J. M., and Gane, R., *ibid.*, p. 156.
[4] Kidd, F., and West, C., *ibid.*, p. 55.
[5] Gane, R., *ibid.*, 1933, p. 122.
[6] Gane, R., *ibid.*, 1934 (in the press).

Introduction of Hindu-Arabic Numerals into Western Europe

EVIDENCE is sometimes adduced to indicate that the Hindu-Arabic numerals, or closely allied forms of them, were known in western Europe before this knowledge could have passed through Muslim Spain. For example, Alcuin of York (735–804) is said to show at least partial knowledge of the numerals. If this is so, whence did the information come?

In this connexion Smith-Karpinsky ("The Hindu-Arabic Numerals", p. 103) point out that adventurous scholars must have gone with ambassadors, travellers and merchants to seek learning in other lands. Reference is also made to a cruciform brooch in the British Museum, perhaps dating from the time of Alcuin, and bearing the Muslim inscription in Kufic characters: "There is no God but God." Smith-Karpinsky ask: If these Kufic characters reached England at that time, why not the numeral forms as well?

When making some notes on the history of money, I collected from various sources fragments of information which may reinforce the implications of the cruciform brooch, and at the same time indicate a route by which some knowledge of the numerals may have reached western Europe in the eighth century.

(1) There is a gold dinar of Offa, King of Mercia, bearing in Latin the words "Offa Rex", and in Arabic the inscriptions: "Mahomet is the messenger of God. . . In the name of God. This dinar was struck in the year 157" (A.D. 774). It may be noted in passing that Alcuin was in touch with Offa on several occasions. An illustrated description of Offa's dinar will be found in Kenyon's "Gold Coins of England", 1884. It is possible that Offa, who, like Charlemagne, was interested in coinage reform, employed Arab moneyers; Arabs being more highly skilled in the arts associated with coining than his own people.

(2) From the eighth century onward, for several centuries, there was a very large volume of trade between north-western Europe and the Orient. We know this because huge quantities of Arabic and Persian coins (Sir T. W. Arnold says upward of ten million) have been found in Scandinavia and other north European countries. The earliest of these is dated 79 A.H. (A.D. 699). Many were minted at Samarkand and at Bagdad. There can be no reasonable doubt that a great number, if not all, reached Europe by the Baltic-Volga-Caspian trade route, along the Russian portion of which many similar coins have been found. As further evidence of Oriental influence, note that the earliest Swedish coinage was based on the Persian weight system, the coins weighing half a Persian drachma. Also, as indicating the far-reaching scope of the trade, note that in the museum at Oslo-Christiana, besides other Oriental coins, there are specimens of early porcelain

money, found in Scandinavia, from Tibet and Siam.

I would add here that some historians have made too much of Viking raids ; overlooking the fact that piracy implies plunder, and plunder implies trade. It is fairly clear that many raids during the eighth century were in fact persistent struggles to secure control of the still highly lucrative Frisian trade and trading stations.

(3) Alcuin spent fifteen years in Aachen, at the home of Charlemagne, whose not unfavourable attitude towards the eastern Arabs is shown by his correspondence and diplomatic exchanges with Haroun-al-Raschid. Aachen was within fairly easy reach of Frisia (much the same territory as modern Holland, where Arabic coins have been found).

(4) In Alcuin's time scholars were more closely associated with commercial activities than might be supposed. The great monasteries of the eighth and ninth centuries were among the largest traders of the time in certain lines. Those which were situated on or near the north European rivers often owned fleets of barges, ships for coasting voyages, and permanent depots for their traffic. They also sent agents to distant cities to buy and sell on their behalf. Arabic coins must not infrequently have passed through the hands of some of these officials ; and as there is evidence that at least a few Arab traders travelled from the East far into northern latitudes, it is not inconceivable that they sometimes (however rarely) made actual contact with monastic agents in the West.

My purpose here, however, is not to enter the region of hypothesis, but to indicate a possible field for research which has not yet been adequately explored.

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Orientation of Oxide Films on Metals

IT was suggested by Tammann[1] in 1922 that the different rates of oxidation exhibited by iron crystals of different orientations can best be explained by a fixed orientation relationship between the lattice of the iron crystal and the lattice of the oxide film. During the succeeding years, fixed orientation relationships have been demonstrated for reaction products of many kinds, such as recrystallisation structures, products of transformation in the solid state, Widmanstätten figures and others ; in view of the general occurrence of such orientation relationships, it now seems more than likely that oxide (and other) reaction films grown on metal crystals will upon analysis also be found to exhibit fixed orientation relationships. Indeed the results of Finch and Quarrell[2], published during the course of our work, seem to prove that films of zinc oxide on zinc, and magnesium oxide on magnesium possess such a relationship, though the analysis does not seem to be complete. We have been successful in demonstrating a fixed orientation relationship for wüstite ("FeO") films grown on iron, and for cuprous oxide films grown on copper.

Wüstite, "FeO", was grown on single crystals of hydrogen-purified, remelted electrolytic iron, by heating at 700° C. in a mixture of hydrogen and water vapour of appropriate composition. Several samples, cooled at a rate which prevented sensible decomposition of the phase, showed, upon X-ray analysis of orientation, the existence of a simple orientation relationship between the oxide film and the base metal. This orientation relationship is as follows : the cube or (100) plane in "FeO" lies parallel to the cube or (100) plane in the iron ; the [110] direction in the (100) plane of "FeO" lies parallel to the [100] direction in the (100) plane of Fe. That is, the cube planes are parallel, but the cube axes in these planes form an angle of 45°. "FeO" has a sodium chloride type of structure with the iron atoms forming a face-centred cubic lattice, the side of which is 4·29 A. The iron atoms on any cube face form small squares (defined by [110] directions), the side of which is 2·99 A. Iron is body-centred cubic, with the side of the cell 2·86 A. The atoms on the cube faces of the two phases, in conjunction in the manner stated, are thus nearly in coincidence. It follows that three orientations of "FeO" can form on each iron crystal, one on each cube face ; these are distinct orientations, for the three "FeO" lattices on inspection will be seen not to be continuous. This orientation relationship suggests that the formation of "FeO" from iron consists in the expansion of the body-centred cubic cell of α-iron to form a body-centred tetragonal cell of axial ratio 1·414, which is identical with the face-centred cubic cell of the iron atoms in "FeO". The oxygen atoms in solid solution in α-iron are probably interstitial ; they may also be so considered in "FeO".

In another experiment, cuprous oxide was grown on a single crystal of copper by oxidation in air. This film is almost entirely cuprous oxide, for only an extremely thin film of cupric oxide is formed. Simultaneous determinations of the orientation of the underlying copper crystal and the cuprous oxide film showed that the cube axes in both crystals lay accurately parallel. The copper atoms in cuprous oxide form a face-centred cubic lattice, and the oxygen atoms form an interpenetrating body-centred cubic lattice ; the side of the unit face-centred cubic lattice of copper atoms in cuprous oxide is 4·26 A., whereas that in pure copper is 3·61 A. In this case, therefore, the oxide film is formed merely by an expansion of the copper lattice without change in orientation. Thus only one orientation of cuprous oxide will form on a single crystal of copper. The orientation relationship described is the more nearly perfect the thinner the film ; as the film becomes thicker the perfection in orientation is progressively lost, owing largely, no doubt, to distortion effects coming from the large difference in volume. At a thickness of 0·002 in., little evidence of preferred orientation remains. Even in the thinnest films there is evidence of lattice distortion, coming probably from the necessity for adaptation in lattice dimensions at the interface, similar to that found by Finch and Quarrell for metallic films deposited on platinum.

How useful these orientation relationships might be in explaining the differences in rates of oxidation on different crystal faces is at the moment quite uncertain. Work now current in our laboratory may, however, lead to definite issue on this point.

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[1] *Stahl und Eisen*, **42**, 617 ; 1922.
[2] NATURE, **131**, 842, June 10, 1933. *Proc. Roy. Soc.*, A, **141**, 398 ; 1933.

Synthesis of Thiocamphor and other Cyclic Thioketones

THIOCAMPHOR has been synthesised in good yield in my laboratory by Mr. D. C. Sen, by the simultaneous action of dry sulphuretted hydrogen and dry hydrochloric acid gas, at 0°, on a solution of camphor in absolute alcohol. The substance is crystallised from aqueous alcohol or from benzene and it melts at 145°. It is a red crystalline substance having the aroma of camphor combined with a slight fœtid smell. Attempts have been made to synthesise the compound by the action of ammonium sulphide or hydrosulphide on camphor, or on the pernitroso derivative of camphor quinone and from bornyl magnesium chloride and sulphur[1]. But in these cases the yield appears to have been low, due to the accompanying by-products, and the purity of the substance also seems to be doubtful, as the melting points described are different in different cases.

The physical and chemical properties of the substance have been studied and important derivatives are being prepared. Thiocyclohexanone (non-polymerised) has been synthesised by the same method along with its tripolymerised derivative. Fromm[2] also studied the same reaction but isolated the tripolymerised derivative only. The method is being extended for the synthesis of cyclic thioketones containing different ring systems. The results of these investigations will be published in due course in the *Journal of the Indian Chemical Society*.

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[1] *Ber.*, **39**, 3503. *Ber.*, **36**, 863. *Gazzetta*, **39**, 11, 196.
[2] *Ber.*, **60**, 2090; 1927.

Series of Cæsium Atoms in an Electric Field

WE have investigated the absorption spectrum of cæsium vapour in an electric field by a method similar to that used by C. J. Bakker in Prof. Zeeman's laboratory[1] and by E. Amaldi and E. Segrè[2] in studying potassium and sodium. The background was given by a high purity carbon arc. A Hilger large quartz spectrograph E_1 was used. A spar

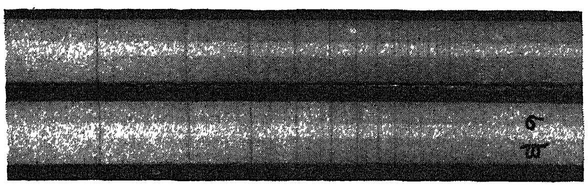

FIG. 1. Absorption spectra of cæsium near the limit of the principal series $6S–mP$: above, without electric field; below, in an electric field of 900 volts/cm.

crystal was placed in the light beam before the slit of the spectrograph, so that polarisations parallel to the electric field (ω-component) and perpendicular to it (σ-component) could be photographed simultaneously and separately.

Fig. 1 shows the absorption spectrum of cæsium near the limit of the principal series $6S–mP$ without an electric field (upper spectrum) and with a field of about 900 volts/cm. (lower spectrum). The first doublet on the left is the $6S–11P$, $\lambda = 3398 \cdot 14$ and $3400 \cdot 00$ A. Without the electric field, one may follow the series $6S\ mP$ up to its thirty-first term; while in the electric field the intensity of the lines diminishes progressively and the series breaks down. The lines of the principal series are split owing to the occurrence of forbidden lines corresponding to $6S–mD$ transitions. For high terms the electric perturbation increases to such a degree that P and D terms become indistinguishable, and the splitting becomes an almost symmetrical one on both sides of the unperturbed P terms. In the region between the permitted lines of the series $6S–mP$, there appear some combination lines belonging to the $6S–mS$ series.

The forbidden lines of the $6S–mD$ and $6S–mS$ series begin to be detectable at a certain value of m (m is 14 for the $6S–mD$ series and 17 for the $6S–mS$ series in the ω component in the electric field of 900 volts/cm.). Their intensities increase with m, until they are stronger than the neighbouring permitted ones; then they become weaker and fade away.

The effect of the electric field is greater on the ω components than on the σ ones.

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[1] *Proc. Roy. Acad. Sci. Amst.*, **35**, 589; 1933.
[2] NATURE, **132**, 444, Sept. 16, 1933.

Interaction of Neutrons and Protons

HEISENBERG's well-known assumption, ascribing the neutron-proton interaction to the exchange of the electric charge, seems to be irreconcilable with Fermi's theory of β-radioactivity[1]. On the other hand, a natural generalisation of Fermi's theory may perhaps account for the interaction of heavy particles.

According to Fermi[2], a heavy particle (a neutron or a proton) may emit (and absorb) a pair of light particles—an electron or a positron and a neutrino. It seems natural to assume that a heavy particle may also emit (and absorb) *a pair of neutrinos*, whereas the emission of a single neutrino would violate the conservation of spin. Of course, in distinction to processes considered by Fermi, the emission of a pair of neutrinos will not affect the charge of the heavy particle.

The Coulomb interaction of charged particles may be deduced from the laws governing the emission and absorption of photons by a charged particle. Exactly in the same way we may calculate the interaction of particles endowed with the power of emitting and absorbing pairs of neutrinos. For the potential energy V of such an interaction one gets

$$V = \frac{\eta_1 \eta_2}{r^5}, \quad . \quad . \quad . \quad (1)$$

where r is the distance between the particles and the 'neutral charges', η_1, η_2, are constants, characterising the properties of the particles in question. It may be assumed that the η-charge of neutrons and of protons are numerically equal and of opposite sign. If one takes account of the finite radius r_0 of heavy particles, one finds that (1) is valid only so long as

$r \gg 0$, and that V remains finite when $r \rightarrow 0$. Estimating the value of η from the mass-defect of the deuton, one finds that the probability of emission of a γ-quantum is for an excited proton far larger than the probability of emission of a pair of neutrinos, so that the latter possibility does not lead to contradictions with experimental facts.

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[1] Ig. Tamm, NATURE, 133, 981, June 30, 1934.
[2] E. Fermi, *Z. Phys.*, 88, 161: 1934.

Symbols for Chromosome Numbers

IN a paper on the chromosomes of *Chrysanthemum*, Shimotomai[1] pointed out the need for a special symbol to represent the basic number of chromosomes in genera containing polyploid species. He suggests, however, that n should be used for this purpose, φ and 2φ being introduced as new symbols for the gametic and zygotic numbers of chromosomes respectively in a particular species. This usage has been followed by Dr. I. V. Newman in a paper[2] recently issued. The need for an additional symbol for the fundamental number in a genus has been evident for some time, but as n and $2n$ have long been in use for the haploid and diploid chromosome numbers of a species, it seems clear that they should remain unchanged, and the new symbol should be introduced for the new conception of a basic number for the genus.

If this suggestion is adopted, then in the genus *Chrysanthemum*, for example, $\varphi = 9$, in *C. indicum* $n = 18$, $2n = 36$, in *C. yezoensis* $n = 45$, $2n = 90$, etc. To show the polyploid nature of particular species we may then write for *C. indicum* $n = 2\varphi$ or $2n = 4\varphi$, showing that it is a tetraploid species. Similarly for *C. yezoensis* we may write $n = 5\varphi$ or $2n = 10\varphi$, showing it to be decaploid. This will avoid the confusion which is bound to result if the use of n to represent the haploid number in any species is changed.

Sansome and Philp[3] have suggested x as the symbol for the fundamental number, but x was formerly used in place of n, and is still so used by some[4]. Hence confusion can only be avoided by adopting a new symbol such as φ for the basic number.

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[1] Shimotomai, N., "Zur Karyogenetik der Gattung *Chrysanthemum*", *J. Sci. Hiroshima Univ.*, *B*, Div. 2, 2; 1933.
[2] Newman, I. V., "Studies in the Australian Acacias. III", *Proc. Linn. Soc. N.S.W.*, 59; 1934.
[3] "Recent Advances in Plant Genetics", p. 165, 1932.
[4] For example, Fernandes, A., "Nouvelles études caryologiques sur le genre Narcissus L.", *Boletim Soc. Broteriana*, 9, 23; 1934.

Points from Foregoing Letters

USING three different methods of stimulating stomach secretions, Prof. B. P. Babkin infers that digestive glands are composed of various sets of cells, connected to separate nerves, so that different types of secretions are possible. Slight stimulation of the vagus nerve causes scanty flow of mucous fluid; stronger current provokes copious flow of gastric juice and digestive enzymes similar to those produced by the sham-feeding of a test-meal; the drug histamine stimulates gastric juice secretion but not enzyme production.

Prof. A. H. Compton of Chicago, now visiting lecturer at the University of Oxford, calculates that the energy liberated in the atomic explosions, observed at higher altitudes by means of the 'cloud chamber', may be so high as 600,000 million volts. This energy would correspond to the annihilation of the mass of an atom of weight 600. No such heavy atom, nor any mechanism whereby several atoms would be simultaneously destroyed, is known. Hence it may be assumed that the atomic explosions are due to cosmic rays, which are known to possess energy of that order of magnitude.

A group of investigators from Switzerland corroborates Hevesy and Hofer's recent inference that water introduced into the body becomes completely mixed with the total water content. The Swiss investigators injected a solution of xylose, a sugar-like substance obtainable from beechwood or jute, in water containing 1·66 per cent of the heavy variety, into the intestine of fasting rats. It was found that the water injected, with the heavy water as indicator, distributed itself throughout the entire body in one hour.

Muscle derives its energy from a chemical change in which the sugar-like substance—glycogen—is transformed into lactic acid. For this conversion several other substances are necessary intermediaries, among them creatine, adenylic acid and their phospho-combinations. Prof. J. K. Parnas and his collaborators, as a result of experiments on muscle pulp poisoned with iodoacetic acid, find that phosphoglyceric and pyruvic acids are also intermediaries, the latter acting as phosphate carrier both in the presence and absence of air, and leading to the formation of phosphocreatine and adenosinetriphosphoric acid.

Various investigators have observed that the proximity of ripe apples and pears stimulates the sprouting of potatoes and the growth of pea-seedlings. Similar effects can be obtained with traces of ethylene. Mr. R. Gane has now been able to detect ethylene among the gases given off by ripe apples.

X-ray studies of crystal structure carried out by Dr. Mehl and his collaborators show that very thin films of oxides (less than 1/500 in. in thickness) grown upon crystals of iron and copper, have an atomic arrangement in definite relationship to the lattice structure of the metals on which they are formed. It is as yet uncertain whether the difference in orientation on different crystal faces is related to the observed variations in the rate of oxidation.

Prof. Tamm points out that the emission or absorption of two neutrinos by the neutron or proton, though less probable than the emission of a γ-ray by the excited proton, is also a possible occurrence. It would not change the spin or the electrical charge of the heavier particle, which would be the case when a single neutrino is given off, as postulated by Fermi in order to account for the emission of β-rays (electrons) by some of the radioactive substances.

Research Items

Weight of Negro Brains. Prof. Raymond Pearl points out in *Science* (Nov. 9, 1934, vol. 90, No. 2080) that the data upon which is based the generally accepted view that the skull capacity and the brain weight of the Negro, whether pure or mixed, tends on the average to be smaller than in whites, are meagre; but the older records contain much of value, only needing biometric analysis for present day purpose. Morton (1849) gives a combined mean cranial capacity for Negroes of 1,360·1 c.c. as against whites, 1,489·6 c.c. (91·3 per cent); Peacock (1865), Negro, 1,295 c.c., as against whites, 1,465 c.c.; Duckworth (1904), Group ii, (African), 1,388 c.c. Group iv, (Eurasian), about 1,500 c.c. (92·5 per cent). Calculations of weight are, Peacock (1865) 1,256·3 gm. (calculated from Peacock's data); Waldeyer (1894) 1,148 gm. and 1,234 gm. (from Topinard). Bean (1927) reported from 117 autopsies that the Negro males had a smaller brain weight than whites, the difference being larger relatively than in respect of either liver, kidneys, spleen, heart, appendix or pancreas. The most recent figures are F. W. Vint (1934), the average adult Kenya male being 1,276 gm., the extremes 1,006 gm. and 1,644 gm.; that is, being 10·6 per cent lighter than a not too sound general European mean brain weight; the average skull capacity was 1,230 c.c. Next to Vint's series, the longest series of Negro brain weights is derived from 400 autopsies made during the American Civil War by Surgeon Ira Russell. These data were dissected by S. B. Hunt and published in the *J. Anthrop. Soc. London*, 7, 1869. The biometric constants have now been calculated. The mean is, white, 1,470·6 gm. $\pm$ 16·2; black, 1,354·8 gm. $\pm$ 6·8. Coefficient of variations, white, 8·02 gm. $\pm$ 0·79; black, 8·87 gm. $\pm$ 0·36. The mean is about 207 gm. greater than Waldeyer's figure and only 78·8 gm. greater than Vint's. The value of the coefficient of variation is not far from the 8 per cent which has been shown to be characteristic for brain weight variability in accurately weighed samples. The mean brain weight for the black series is 92·1 per cent of the white, agreeing approximately with Morton, Duckworth, Peacock and Vint. The smoothness in the decline of the means with a putative increase in Negro blood is noticeable. The relative variability of the Negro brain weight appears to be slightly greater than that of the whites.

'Little People' of the Gold Coast. Mr. M. J. Field contributes to *Man* of December an account of the *Asamanukpai* of the Gold Coast—dwarf-men, with feet turned back to front, a little bigger than a monkey, and black, white or red, who inhabit a forested hill behind the Ga village of Bawyi, where monkeys and pigs live, but which no hunter will visit by himself, because of fear of these 'little people'. The old dwarfs are the biggest and they are bearded. They eat and dance on outcrops of stone which they themselves have polished. The disc-shaped quartz thunder-stones, holed through the middle, which are plentiful in the district, are said to have fallen from heaven; but they are also said to have had their holes made by being caught, as they fall, between the finger and thumb of an *asamanukpa*. Hunters who have to invade their district propitiate them with rum, which is laid against their dancing stones. If angered, they stone the offender and, leading him away into the forest, lose him. Sometimes they lead away a man to befriend him, and then they teach him all they know. When he returns to his home after a week or two, he becomes a much revered fortune teller. The dwarfs are known by the sea as well as in the forest. Before the lagoon was drained, they were so plentiful that one day in the week, Friday, was set aside for them and no one would go to the shore to fish on that day. According to one story, they acted as the benefactors of two fishermen and brought them good catches night after night; but when the fishermen spied on them, the luck vanished and in a few weeks the fishermen died of melancholy. The *Asamanukpai* seem comparable to the *mmatia* described by Rattray, who seems to think that there may be a reminiscence of a real pygmy tribe, as has been suggested for the origin of the fairy belief in Europe. It is possible, however, that the belief may have originated in the form of lunacy familiar in European lunatic asylums, in which the patient suffers from the delusion of seeing 'little people'—usually said to be due to 'frustrated maternal instinct'. Though this would not take in every case on the Gold Coast, there does seem to be some evidence for regarding normal married life as a bar to fairy friendship.

Studies of Identical Twins. *Character and Personality*, 3, No. 1, contains a full account by Mr. Robert Saudek of psychological tests carried out on "A British Pair of Identical Twins Reared Apart". This is the first case to be traced in the British Isles. Careful comparisons were made between the finger and palm prints of the two brothers, and the conclusion was that finger print patterns are not a reliable index of identical twinning, although palmar markings are very similar. Various emotional and intelligence tests were given and these were supplemented by a graphological analysis. Owing to this being but a single case, only tentative conclusions as to the influence of environment on identical genetic constitution have been propounded. The main conclusion is that there is greater similarity in intelligence than in emotional reactions. The chief differences in personality appear to be of degree rather than kind. One twin is apparently "more extroverted and sociable, better adjusted, somewhat self-assertive and rather independent and on the whole more impulsive and the quicker of the two. The other is less extroverted, according to some tests even introverted and less well-adjusted; he also shows inner instability and more cautiousness". This is the nineteenth of such cases to be investigated.

Blood Groups of Rabbits. New facts concerning the blood groups of rabbits are brought out in an article by Drs. C. E. Keeler and W. E. Castle (*J. Heredity*, 25, No. 11). They find two agglutinogens which they call H_1 and H_2, thus making four blood groups (H_1, H_2, H_1H_2 and O), as in man. The corresponding agglutinins, h_1 and h_2, are, however, not normally present in the blood plasma of rabbits, at least in sufficient quantity to produce a reaction. But if blood from a rabbit containing an agglutinogen is injected into a rabbit which does not have this agglutinogen, then the corresponding agglutinin arises as an immune reaction. It is also shown that if a O female rabbit is injected with blood from an H_1H_2 rabbit, the agglutinins h_1 and h_2 will develop

in her blood and will be transmitted through the placenta to the blood of her offspring. It was found that the agglutinogens are already developed in embryos only 14 mm. in length, while in still younger embryos 4 mm. long they were present in the nucleated blood cells. These facts led to the anticipation that in certain matings incompatibilities would develop between mother and fœtus. No such results were found, however, from mating a O mother with an H_2 father. Three litters of young, numbering 14 in all, included 9 young rabbits with incompatible red corpuscles, but none of them showed adverse effects. The basis of this protective action is not at present understood.

Antarctic Nudibranchs. In his account of the nudibranchs in the British Antarctic (*Terra Nova*) Expedition Reports (Zoology, vol. 7, No. 5; 1934) Dr. Nils H. Odhner considers that the subdivisions Cladohepatica and Holohepatica should be abandoned, as they are not adequate to cover every form of liver differentiation in the nudibranchs. Further, the cladohepatic organisation does not imply a uniform or monophyletic development, for the branching of the liver may be brought about in different ways, and hence does not form a basis for a natural classification. The author divides nudibranchs into four groups—Doridacea, Arminacea (a new division which comprises the genera and families grouped round *Armina*), Eolidacea and Dendronotacea. In describing a new species of *Bathydoris* collected in McMurdo Sound, at a depth of 366 metres, he supports the view of Evans that the gills of Dorids are to be considered as homologous with the ctenidium in the Tectibranchia. The gill in this new species consists of a right and a left stem, the left one in front of the anus, the right one on the right of the anus. One new genus and nine new species are described.

Parasites of Lepidoptera. Miscellaneous Publication No. 188 (July 1934) of the U.S. Department of Agriculture is entitled "Macrolepidoptera and their Parasites Reared from Field Collections in the North-eastern Part of the United States", by Messrs. J. V. Schaffner and C. L. Griswold. This bulletin is the result of studies begun in 1915 at the Melrose Highlands Laboratory of the U.S. Bureau of Entomology, and it brings together a large number of records and data respecting hymenopterous and dipterous parasites bred from the larger Lepidoptera. It is divided into two sections, which facilitates reference. The first consists of a host list with the respective parasites, while the second part is a classified list of parasites with their known hosts. During the course of the work, twelve new species of Tachinidæ and twenty-one of Hymenoptera were bred and have already been described, while many more await description. The publication is one likely to interest workers on biological control, and on host-parasite relationships, in Europe as well as in North America.

Production of Dwarf Amphidiploid Tobacco Plants. In a series of cross pollinations of certain *Nicotiana* species, Prof. Dontcho Kostoff, of the Institute of Genetics, Moscow, reports in a communication to NATURE that *N. glauca* ($2n = 24$) gave inviable embryos with *N. rustica* var. *humilis* ($2n = 48$), but viable plants with *N. rustica* var. *texana* ($2n = 48$). The resulting hybrids were, however, self-sterile and showed irregular meiosis. When pollinated by *N. rustica* var. *humilis* (or var. *texana*), a variety of plants with chromosome numbers ranging from 48 to 96 was produced. Among these were two tetraploids (amphidiploids) with 72 chromosomes. They were dwarfs, growing to a height of 12 cm. and 73 cm. respectively, the latter being self-fertile. Under similar conditions, the parental species reached a height of 80 cm. and 150 cm., and the F_1 hybrid 150 cm. Hence the result of the chromosome doubling is to reduce the size. Too great an increase in chromosome number also lowers viability. There are few plants in Nature with 200 or more chromosomes, but these plants are never 'giants' in comparison to the other species of the same genus having a smaller chromosome number.

The Genus *Isaria*. *Isaria* is usually thought of as the name given to a genus of fungi the principal members of which attack various insects, and send up small, ivory-white, branched conidiophores, often about half an inch high. The group has, however, been used as a taxonomic reservoir for many apparently unrelated species, as is shown by Mr. T. Petch ("Isaria", *Trans. Brit. Mycol. Soc.*, 19, Part 1, 34–38, Oct. 1934). The paper traces the chequered history of the genus since it was first mentioned by Hill, apparently to denote a species of *Puccinia*. The principal authorities quoted are Persoon, Nees, Saccardo, Lindau and Fries. Persoon appears to have originated the modern conception of the genus, and must be cited if the genus is to be retained. Mr. Petch suggests, however, that the species could all be included amongst the various existing genera of the Mucedinaceæ, a simplification which should commend itself to most mycologists. He has a wide experience of entomogenous fungi, and it is gratifying to note that increasing knowledge is leading to simplification of classification, rather than to its complication.

World Coffee Production. The International Institute of Agriculture, Rome, has issued a monograph entitled "Coffee in 1931 and 1932: Economic and Technical Aspects". This publication, which has been prepared by Dr. W. Bally, is the first of a series of monographs that it is intended to publish on the principal crops grown in tropical countries. The subject is treated from a variety of aspects, opening with an introductory account of the economic situation of the coffee industry in general. Statistical data on production, consumption and prices follow, but the major portion of the monograph is devoted to a detailed account of the economic position in each of the various coffee-producing countries of the world. The present phase of over-production seems to have been brought about largely by increase in area under the crop, rather than by higher yields due to agricultural improvement as is the case with sugar and rubber. Further, over-production is probably a temporary phenomenon only, and agricultural problems such as soil exhaustion already evident in Brazil, or pests and diseases are in reality of no less importance than the economic. A further section of the monograph takes the form of a review of works dealing with the technical and ecological aspects of coffee growing, and a detailed account of the fungus and insect pests that attack the crop in the different countries follows, even a hasty perusal of which will impress the reader with the serious problems on this side of coffee growing. An account of the product and its preparation forms the subject of the final part of the monograph. Considerable value is added to the whole publication by the inclusion of a bibliography at the end of each sub-section.

Phosphatic Calculi in Silurian Polyzoa. The results of a palæo-biochemical investigation of the pearl-like spherules found in the zoœcia of Ceramoporoid Polyzoa from the Wenlock and Gothland Limestones are recorded in a paper of unusual interest by K. P. Oakley (*Proc. Roy. Soc.*, B, 116, 296–314; 1934). The spherules resemble pearls in respect of their opalescent lustre and fine concentrically laminated structure, but they are shown to consist of crypto-crystalline calcium carbo-phosphate (dahllite). It is probable that the 'pearls' were formed by the simultaneous precipitation of carbonate and phosphate around nuclei in the cœlomic fluid of the separated distal portions of the zooids after periods of polypide degeneration. The fact that a strongly alkaline solution was a necessary condition for precipitation of phosphate suggests that the main factor was a marked rise in the pH value of the cœlomic fluids during the periodic degeneration of the internal organs. Such rise would presumably be brought about by ammoniacal decomposition of proteins. The liberation of ammonia might also account for the association of carbonate with the phosphate. From the results of the experimental work of Schade on the formation of concretions, the mode of growth of the spherules has been deduced. The spherules are clearly of the nature of calculi; they are comparable with such pathological structures as human gall-stones and bladder-stones.

Ordovician Faunas of Korea. A monographic account of the Middle and Upper Ordovician faunas of South Chosen (Korea) is given by T. Kobayashi (*J. Fac. Sci. Imp. Univ. Tokyo*, Sect. 2, 3, pts. 8, 9, 1934, pp. 329–585, pls. i–xliv, i–viii). In the Middle Ordovician the Chikunsan fauna includes 87 species and corresponds to the Upper Llandeilian of Europe; it is remarkable for the great development of Nautiloid Cephalopods, which show relationship to those of central and southern China and also to those of the Upper Chazyan of North America. The Trilobites are mainly Asaphids. The Tsuibon fauna corresponds to the Lower Caradocian, and its Cephalopods are mainly Actinoceroids. In the Upper Ordovician the Tomkol and Shokudo faunas are of interest as representing new or little-known horizons in eastern Asia. These faunas are divided into three zones: (1) *Asaphellus*, (2) *Protopliomerops*, and (3) *Clarkella*. The first and second show relationship to European faunas, the first corresponding to the British Tremadoc, the second to the *Apatokephalus* zone of the Baltic region. The *Clarkella* fauna, on the other hand, is of a Pacific type. Trilobites form the main part of the fauna; other groups represented are cystids, worms, brachiopods and molluscs.

A World-Wide Survey of Microseisms. *Geophysical Memoir*, No. 62 (Meteorological Office, 1934; London: H.M. Stationery Office, 3*s.* net), with this title, embodies an important study by A. W. Lee of microseisms observed during a single month, January 1930, in many parts of the world. The study is based on the records of no less than fifty-seven seismological observatories; the data studied are presented in numerous tables, reproductions of records, diagrams and synoptic charts. It is shown that the mean east-west and north-south amplitudes of microseisms, though normally equal, are different if the local geological formation round the station is unsymmetrical; the local geology also affects the ratio of the mean horizontal and mean vertical amplitudes, which varies at different stations from 3 to 0·6. A method is developed of allowing for these local peculiarities of substructure and putting the data from different observatories on a comparable basis, so that the geographical distribution of microseisms can be properly mapped. Usually, Iceland and the British Isles are affected by much larger microseisms than the continental area of Europe. In Europe, microseismic storms are generally associated with cyclonic depression off the coasts, though such depressions do not always produce large microseisms.

Capture of Electrons by Positive Ions. R. A. Smith (*Proc. Camb. Phil. Soc.*, 30, 514; 193[illegible]s examined the exponential decrease of intensity of a beam of protons or He^+ ions passing through helium gas. The slits of the collector were so wide that the ions scattered through small angles were not excluded, and under these conditions the loss of intensity is due mainly to neutralisation of the ions in the beam by the capture of electrons from the helium atoms. The ions were drawn out of a low-voltage arc and accelerated to energies of a few kilovolts. The beam was collected by one of several shielded Faraday cylinders. The results were compared with the theory of Massey and Smith and show fairly good agreement. The case of He^+ ions in helium is a case of 'resonance' and the cross-section for capture falls off steadily with increasing energy. Protons in helium or in hydrogen show a maximum at a certain energy of the ions. According to theory, capture does not become important in this case until the ions have a certain energy (activation energy) and the probability of capture passes through a maximum and falls off with increasing energy.

Spaced-Aerial Radio Direction-Finders. It is now well-known that the ordinary closed-coil type of radio direction-finder is seriously limited in its application in the presence of downcoming waves polarised with their electric force in a horizontal direction. The basic principle of the means of overcoming this limitation, so as to enable correct bearings to be obtained under all conditions of radio reception, was patented by F. Adcock in 1916. This method utilises a system of spaced vertical aerials, and the principle was verified experimentally in 1926. Since that time, the system has been under continuous investigation in Great Britain, with the view of its development as a practical instrument of navigation. In a paper, entitled "Some Principles underlying the Design of Spaced-Aerial Direction-finders", read before the Wireless Section of the Institution of Electrical Engineers on December 5, Mr. R. H. Barfield gave an account of the results of a quantitative examination of the various aerial systems by means of which Adcock's invention may be realised in practice. To enable this examination to be carried out, the author has introduced two quantities, termed 'standard-wave error' and 'pick-up factor' respectively, by means of which the relative performance of different direction-finders may be assessed. In some cases, the method under discussion was amenable to theoretical calculation, and the agreement between values of performance obtained in this way and the experimental results was found to be satisfactory. The paper concludes with a comparative table of standard wave errors and pick-up factors for the ordinary closed-loop direction-finders, and for six different arrangements of the spaced-aerial systems. This table, together with the detailed conclusions given, serves to illustrate clearly the stage at which this phase of radio research has arrived.

Forest Policy in New Zealand

NEW ZEALAND'S Arbor Day is held on August 1, and on the previous day this year, Lord Bledisloe, Governor-General of the Dominion, delivered an address at the annual meeting of the New Zealand Forestry League. He took as his text, "New Zealand's Timber: A Great National Asset" (Wellington, N.Z.: Blundell Bros, Ltd., 1934). The position of the afforestation question in New Zealand has been discussed in NATURE on several occasions, and Lord Bledisloe's review covered many of these points in connexion with the exotic plantations formed by the State and those of private companies and others amounting to 396,000 acres and 260,000 acres respectively.

The most interesting and, as some foresters will think, the most valuable part of Lord Bledisloe's address was that dealing with the remaining indigenous forests of the country. In recent months, special attention has been directed in NATURE to the position of these forests, and the opinion expressed that they should receive attention on the part of the skilled forester. On this subject, Lord Bledisloe's opinions after visiting many of these areas are of value:

"To those interested in forestry scientifically, ecologically, archæologically, and romantically (not to mention æsthetically), rather than commercially, it is the indigenous forests rather than the exotic forests which make a strong and special appeal. There is, in fact, a glamour about these ancient tree communities which grips the mind of those interested in the natural products of their country, and such, I know, form no inconsiderable number amongst members of the Forestry League. According to the late Dr. Leonard Cockayne, the indigenous forests as a whole differ essentially from those of the temperate parts of Europe, Asia and North America, so that the forestry practice of Europe in general cannot apply to New Zealand, and it is the foresters of this country who must put forth rational methods for their permanent management, and who also must decide, in friendly co-operation and consultation with enlightened agriculturists, what shall be permanently preserved as forest land, and what shall be concerted into pasture."

The late Dr. Cockayne considered the study of the New Zealand rain forest, dependent on a heavy rainfall, as peculiarly difficult for the scientific forester, owing to the slow but constant changes which are always in progress, new combinations of plant and timber growths coming into being only to pass away and gradually to give place to other combinations. The same is, however, common to this type of forest in India and West Africa, and there does not appear, on the face of it, any reason why the regeneration of the type should prove more difficult in New Zealand than in the other countries where the necessary technique based on a close study is being acquired.

That the Forestry Department in the country is now turning its attention seriously to this question of the indigenous forests, the annual report of the State Forest Service for the year ending March 31, 1934 (Government Printer, Wellington, 1934) well shows. Here, the Director of Forestry, Mr. A. D. McGavock, points out that owing to the prominence given to the afforestation work with exotics during the past nine years, it has become necessary to restate the policy under which the forest service is operating. This policy is two-fold—the maintenance of climatic, soil and water equilibria, and the supply of timber and other forest produce. Owing to its influence upon agriculture, the former objective, namely, the conservation and the protection of the forests is of greater national significance.

"Conservation," says the Director, "may be defined as the preservation of the forests by wise use, and the intensive management of these forests will assist to solve the problem of timber-supplies. It is with this latter consideration that the establishment of exotic forests is most intimately associated."

"The outstanding features of the national timber-supply situation are—

(1) That of the remaining virgin forests over 80 per cent. are overmature stands in which there is no net growth. New growth is offset by decay, &c.;

(2) That the conversion of this 80 per cent. of overmature forests into healthy growing stands of indigenous species producing timber to the maximum capacity of the forest soil will necessitate silvicultural management extending over a long period, probably one hundred and fifty years;

(3) That current timber demands are depleting the virgin indigenous forests at such a rate that, without other provision being made, an adequate supply of timber would not be available during the whole of the intervening period;

(4) That the early establishment of exotic plantations as a supplementary forest capital resource is therefore of great importance, and it is for this reason that the establishment of large forests of exotic trees has assumed such proportions during recent years;

(5) That the part which these exotic forests will ultimately play in the forest economy of the Dominion, one hundred to one hundred and fifty years hence, is difficult to predict. Experience in foreign countries where forestry has been practised over a period of several centuries indicates, however, that exotic species have definite limitations, and for this reason the national policy must envisage the management of the indigenous forests to secure their maximum possible production of timber."

It is proposed that on the early completion of the exotic forests, as a supplementary resource, more attention will be given to the sylvicultural treatment of the indigenous forests.

There are some interesting remarks on the "Management of Indigenous Forests". The Director states that the public appears to think that all that is necessary to preserve this type is to fence against stock and to protect them against fire. This idea he holds is quite erroneous since "The composition of forest gradually changes, one type of forest growth succeeding another. Generally the valuable timber-producing species are replaced by weed species".

These changes are common to all primeval forests, but in their natural state the change from one forest type to another probably takes many centuries. When man interferes, with destructive fellings, fire and so forth, the process is quicker. But there does not appear any reason to imagine that the difficulties which the New Zealand scientific forest officer will have to face in the regeneration of the indigenous forests will prove greater than those which have faced the forest officer in India during the past half century,

some of which have been successfully surmounted.

The following remark will be read with appreciation by those having the forest policy of the British Empire at heart. "The general forest policy may be stated as the perpetuation of the indigenous forests and the provision of a supplementary exotic-forest capital which, by rapid growth, will eke out the supplies of indigenous timber and bridge the gap between the exhaustion of the overmature indigenous forests which otherwise would occur, and their conversion into healthy productive forests. With the establishment of the exotic plantati now approaching completion, it will be possible give proper attention to the silvicultural treatm of the indigenous forests. The timber-supply posit of the future envisages a balanced yield from b exotic and indigenous forests, and the future al will determine the relative importance of the sources of supply."

It is refreshing to have a forest policy for a coun so clearly laid down, and one calculated to fulfil objects aimed at and the requirements of the peo

British Hydro-Electric Development

THE paper on "Hydro-Electric Development in Great Britain", read at a meeting of the Institution of Electrical Engineers on November 8 by Messrs. A. S. Valentine and E. M. Bergstrom, dealt more particularly, as indicated by its sub-title, with the works of the Grampian Electricity Supply Co., but it contained an interesting summary of the present situation of hydro-electrical development in the country. It is well known, of course, that the water-power resources of Great Britain do not compare in extent with those of some other countries, but, on the other hand, there are abundant supplies of coal, and by reason of this cheap and adequate supply of fuel for steam-power plants, water-power developments here do not present the same attraction as they do in countries lacking carboniferous deposits but possessing abundant water resources.

At the beginning of the present century, the census of power production showed that less than two per cent of the power requirements of Great Britain was produced from water-power. "By reason of the fact," say Messrs. Valentine and Bergstrom, "that in Great Britain water power can only be regarded as a contributory element, supplemental to the main power supply derived from coal, the technical and economic factors enter far more prominently into the problem of its utilisation than in countries where the economic policy is dictated by far less onerous conditions and where the natural advantages facilitate the solution of the many difficult technical questions inevitably connected with water-power developments".

According to the report of the Water Power Resources Committee constituted by the Government in 1918, the estimated output on a continuous basis for Great Britain was 250,000 kilowatts, in the ratio of 8 per cent, 77·5 per cent and 14·5 per cent for England, Scotland and Wales respectively. The limited resources of England, say the authors of the present paper, are easily appreciated in view of the low average elevation above sea-level, and the consequent flat gradient of the rivers, which must form the principal source for water-power development. Developments of any size cannot be looked for, but notable examples of what can be achieved to a limited extent are provided by the installations at Chester and Worcester and the more recent development at Linton Lock, York. The available fall does not exceed 11 ft. in any of these installations and the total electrical energy generated aggregates not more than an average of 5·25 million kwh. per annum.

In Wales, the conditions are more favourable, particularly in the northern area. The total energy available from the hydro-electric plants in operation in North Wales is about 95 million units a year. This total can probably be increased to appr mately 140 million units a year. Apart therefr any further large developments cannot be anticipa in Wales, owing to the limited extent of availa catchment areas.

The topographical features of the Highlands Scotland, which are the most prolific source of sup in Great Britain, are favourable, the country be mountainous and consisting mainly of impermea strata with steep slopes and comparatively h average rainfall. The area is also characterised numerous lochs, situated at a considerable elevati which can be utilised as impounding reservoirs low cost. Among installations already made, or progress, may be instanced those at Lochaber (80C head; 33,000–75,000 kw.), Tongland (102-ft. hea 36,000 kw.), Tummel (160-ft. head; 34,000 kw Rannoch (465-ft. head; 32,000 kw.) and Kinlc leven (900-ft. head; 23,000 kw.).

If the cost of transmission be left out of conside tion, it can be accepted as a general condition for adoption of a hydro-electric scheme in Great Bri that the economic limit of capital cost is the amo represented by the capital cost of a thermal stat of equivalent output plus the capitalised value the annual cost of fuel. When the cost of coa relatively low, as here, the economic margin in fav of hydro-electric power is correspondingly redu in comparison with countries in which the cost fuel is high, and consequently the field for devel ment is much more restricted. The load facto also a matter of importance. With continu operation at a high load factor, the economic mar is increased, and it diminishes with a decreasing l factor to a point at which it changes over in fav of steam plant. Questions of transport of mate and availability of skilled labour also enter into problem. The interconnexion of steam and hyc electric power plants will, in certain cases, prom the best economic results by utilising the availa water flow to the greatest advantage, particula if possibilities of storage are absent or defici With the construction of a Grid and the co-ordinat of electric supplies on a regional basis, opportuni are afforded for a wider application of hydro-elec stations to supplement the supply from large ste generating stations.

Messrs. Valentine and Bergstrom also touched u the subject of electrical generation by tidal pov the conditions for which are most favourable the west coast of England and Wales. They st that the technical difficulties in obtaining effici results from water turbines operating under onerous conditions of a widely fluctuating head water have now been satisfactorily disposed through the introduction of the Kaplan and ot

types of propeller turbine. The utilisation of tidal power resolves itself, therefore, into an economic question in relation to other available, or potential, power supplies in the area under consideration. As a rule, the cost of the civil engineering works is considerable, so that tidal-electric developments can only be contemplated at certain selected sites, as on the Severn, where the topographical features and other conditions in respect of the foundations, the tidal flow and the geographical position in general, favour the production of a large block of electrical energy at the lowest possible cost per unit. The large amount of capital required in such cases makes it unlikely that they could be financed from private sources alone, and Government aid must be forthcoming for their realisation.

Inheritance and Mental Deficiency

IN a paper on the inheritance of mental ability read at Aberdeen before Section J (Psychology) of the British Association, Dr. L. S. Penrose gave an account of a survey of a group of mentally defective patients whose relatives were tested by standardised intelligence tests. The patients were grouped into severe and mild cases, and certain significant differences were found between the two groups. The relatives of the severe cases were, on the whole, distinctly more intelligent than the relatives of the milder cases, and there was a marked incidence of consanguinity among the parents of the severe cases.

Dr. Penrose concludes that the influence of heredity in the causation of severe mental deficiency is shown (1) by the sharp distinction between normal and abnormal brothers and sisters; and (2) by the high incidence of consanguinity among the parents, which indicates the presence of rare recessive characters. The arguments against hereditary influence are the possibility of causation by physical disease among the patients and the demonstrable importance of environmental factors—as in mongolism. The low familial incidence is not strong evidence against hereditary causation here because severe mental deficiency tends to cause family limitation, and the affected individuals do not have offspring.

Within the group of mild cases, where the mental ability extends from 40 per cent to within the normal range, hereditary influence is indicated (1) by the high familial incidence of mild defect, and (2) by the characteristic regression towards the normal of the mean intelligence of relatives. In the absence of sharp segregation, these findings suggest multifactorial inheritance. The points indicating the influence of environmental causation are the lack of correlation between mentality of patient and mentality of relative as judged by the Binet tests, and the poor social conditions under which defectives of this group are nurtured.

A practical consequence of the lack of correlation between the test scores of patients and their relatives is that, within a wide range, the knowledge of the mental grade of an individual gives no information about the probable mentalities of brothers, sisters or children. One can only say that, given a large enough group, the average mentality of the relatives of defectives will be a certain distance below the normal. This fact puts serious difficulties in the way of the application of eugenic measures designed to control mental defect; it points to the importance of exercising educational and social influences to the fullest extent.

Mr. D. Kennedy-Fraser discussed in a paper before Section J the immature reactions to number of older feeble-minded boys. A group of 200 older feeble-minded boys reacted to five groups of $x\,n$ dots. The responses are classifiable into 288 primitive unit counting, 445 adding by groups, and only 289 multiplicative reactions. On the other hand, a comparative group of 76 normal boys of the same age only gives 2 per cent unit counts, 9 per cent additions and 89 per cent multiplications. Further investigation is to be made into the probable relation between mental age and number maturity with both normal and subnormal girls and boys.

Structure of Amphoteric Ions

IN a communication to the September issue of the *Berichte der deutschen chemischen Gesellschaft*, Werner Kuhn and Hans Martin discuss recent conclusions as to the structure of amphoteric or *zwitter* ions from measurements of dielectric constants.

The important part which amino-acids play in biochemical processes has attracted attention to their properties, and numerous observations of dielectric constants of aqueous solutions of these compounds have been made in recent years.

It has been noticed that the rate of change of dielectric constant with concentration, particularly in dilute solutions, varies between -10 and zero in the case of compounds like aniline, biuret or acetanilide, which do not yield amphoteric ions, whereas the amino-acids and their derivatives give high positive values, ranging from $+23$ in the case of alanine to $+290$ for heptaglycylglycine. While there seems to be general agreement that this discrepancy is the direct outcome of amphoteric ion formation, the present authors believe that incorrect conclusions have been made about the form of the molecular chains. Thus in the United States, Messrs. Wyman and McMeekin have found that the rate of change of dielectric constant with concentration increases proportionally with the length of the chain, and conclude that the molecules exist as long, rigid, extended rods.

Now the nature of the equilibrium between different dipolar molecules is not yet well understood, so that at present one has to be content with an incomplete mathematical analysis. Even an approximately accurate determination of dielectric constants in a strongly polar medium like water is at present out of the question. Nevertheless, one ought not to ignore the requirements of the existing formula, which, as is shown, leads undoubtedly to low values for μ, the effective electric moment. Thus for hexaglycylglycine, the value of μ works out to about $3{\cdot}4 \times 10^{-18}$, whereas an extended rod-like structure would necessitate a value of about 180×10^{-18}. The authors feel justified, therefore, in concluding that the rod structure is highly improbable, and point out that existing evidence does nothing to invalidate the older theory of chain-coiling.

University and Educational Intelligence

CAMBRIDGE.—Sir Daniel Hall has been appointed Rede lecturer for the year 1935. The lecture will be delivered at 5 p.m. on Monday, March 4, 1935.

Dr. M. E. Adair, of Girton College, has been elected to a second John Lucas Walker studentship.

LONDON.—The title of emeritus professor of civil and mechanical engineering has been conferred on Prof. E. G. Coker on his retirement from the Kennedy chair of civil and mechanical engineering at University College.

Prof. A. E. Jolliffe, professor of mathematics at King's College since 1924, and Mr. Noel Ashbridge, a former student of King's College, chief engineer to the British Broadcasting Corporation, have been appointed fellows of the College.

SHEFFIELD.—The following appointments have been made: J. C. Anderson, as a lecturer in applied anatomy and demonstrator in anatomy; A. W. Fawcett, as lecturer in surgical pathology; E. F. Skinner, as lecturer in psychology in the faculty of medicine.

A CECIL PEACE PRIZE of £100 is being offered in 1935 to members of any university or university college in Great Britain or Northern Ireland for an essay on the following subject: "The Manufacture by Private Enterprise of Munitions and Implements of War is open to Grave Objections. How far is this true and what is the Remedy?" Further information can be obtained from the Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

ADMISSION to secondary schools being, for many children, contingent on the results of scholarship examinations, it is a matter of considerable national importance that they should be conducted with a maximum of knowledge, intelligence and care. The report of the Education Committee of the West Riding of Yorkshire on the examinations for county minor scholarships, 1934, affords evidence that the Committee is fully alive to their importance. It is only in connexion with the recommendation of candidates for admission to the examination that the Committee finds cause for anxiety as to the working of its scheme. The meshes of the net spread for catching the gifted children seem too wide for the younger ones in the age group 10–11, for only 22 per cent of the children whose tenth birthday fell in the quarter January–March were recommended for admission as compared with 36 per cent of those who reached that age in the preceding April–June, and a similar disparity was noticed in the preceding year. It is thought to be due to overlooking the merits of children who have not completed all the work undertaken in the class from which candidates are usually presented. The chief examiner in English comments on the prevalence, more conspicuous this year than ever before, of a tendency to read the questions carelessly and to introduce irrelevant matter into the answers. Much, one feels, might be forgiven to the girl who put into the mouth of the conductor of a 'bus which was in danger in a fog the appeal—"Keep your heads and your seats, for peril is nigh". The report on the examination in arithmetic throws interesting sidelights on various methods of teaching.

Science News a Century Ago

The *Beagle* sails Northward

By the end of 1834, Capt. FitzRoy had practic completed the survey of the Chonos archipelago much to Darwin's relief the *Beagle* again hea northward. On December 30 he recorded: ' anchored in a snug little cove at the foot of some hills near the northern extremity of Tres Mont Next morning a party ascended one of the mo tains. "The scenery," he says, "was remarka The chief part of the range was composed of gra solid, abrupt masses of granite, which appeared i they had been coeval with the beginning of world. . . . I took much delight in examining structure of these mountains. The complicated lofty ranges bore a noble aspect of durabili equally profitless, however, to man and to all o animals. Granite to the geologist is classic grou from its widespread limits, and its beautiful compact structure, few rocks have been more ancie recognised. Granite has given rise, perhaps, to n discussion concerning its origin than any o formation." The day following his ascent of mountain, on January 1, 1835, Darwin wrote: " new year is ushered in with the ceremonies prope it in these regions. She lays out no false hopes heavy north-western gale, with steady rain, bespo the rising year. Thank God, we are not desti here to see the end of it, but hope then to be in Pacific Ocean, where a blue sky tells one there heaven,—a something beyond the clouds above heads."

J. D. Forbes and his Researches on Heat

The opening of the year 1835 found Forbes grossed with his heat investigations, and on Janua he wrote to Whewell: "I am quite full of polarizat I do not exactly understand what you mean double refraction existing without polarization, at all events since I wrote to Airy I have made g progress. My original experiments related to po ization unconnected with double refraction, bu have since extended the proof to every recogn species of polarization; and non-luminous h must be doubly refracted, because it can be pola by tourmaline and depolarized, or di-polarized if will by other crystals. Hence we are entitled conclude that we might feel brushes and rays of c heat if our hands were delicate enough thermomet I can also make some approximation to the len of a wave. I have as yet communicated this to one. I shall read it on Monday to the Royal Soc when it will be immediately printed." He conclu his letter by asking, "Have you anything to about the Rumford Medal? I think Melloni ou certainly to get it, for his two masterly paper the *Annales de Chimie*. There have been few of adjudications for researches so accurately fulfil the founder's intentions."

Eruption of Vesuvius

The first note in the chronicle of events of Janu 1835 given in the "Annual Register" for that y is an extract from a letter written from Sorre giving an account of an eruption of Vesuvius. " scarcely possible to imagine," the writer said, "m less to describe the awful character of the scene. immense body of liquid fire silently, yet rap

advancing; then the noise of falling poplars encircled by clustering vines laden with fruit, with the glare reflected upon us from the flowing lava, produced an effect altogether so terrific that I was at first more inclined to a hasty retreat than to continue watching the progress of destruction . . . the stream of lava must have been a mile and a half broad whilst its extent from the crater was nine miles, with a depth of thirty feet, so that instead of commencing with the base of the houses, it approached and flowed at once over their roofs; entering the doors and windows till the whole was buried, the roofs falling in with a loud crash. . . . According to Salvator, the lava, which continued flowing more or less for six days, destroyed about 300 acres of valuable land and injured or destroyed nearly 800 houses. . . . Pompeii was considered not to be free from a second interment, Naples herself not free from risk. The old crater had previously fallen in, and had continued for a week throwing out ashes in such quantities as to envelope many neighbouring districts in darkness. . . ."

Societies and Academies

Paris

Academy of Sciences, November 26 (*C.R.*, 199, 1165–1260). Louis de Broglie: The expression of density in the new theory of the photon. Charles Nicolle and Paul Giroud: The non-transmission to the rat, by ingestion, of the bacillus of historical typhus contained in infected lice. Lucien Daniel: A case of accidental crossing in the bean. E. J. Gumbel: The final distribution of values near the median. G. Darmois: The theory of two Spearman factors. J. R. Braitzeff: The representation of the function which is given by its development in a Dirichlet series. Pierre Bergeot: The convergence in quadratic mean. Max. Serruys: Conditions imposed on the working characteristics of internal combustion motors by the necessity of avoiding detonating régimes. An application of the theory of nuclear inflammation given in an earlier communication, with experimental confirmation. Marcus Brutzkus: A method for the appreciation *a priori* of the shock effect of combustibles. Binayendra Nath Sen: The diffusion of elements in the solid state. A new view. Albert Turpain: The echoes of short waves and attempts to explain these phenomena. Marcel Pauthenier and Mme. Marguerite Moreau-Hanot: The suppression of the coronal discharge by particles in suspension in the electric field. Raymond Jouaust: The variation of the rigidity coefficient of nickel as a function of the magnetisation. Jacques Métadier: The action of the magnetic field on the Brownian movement. From the results of numerous experiments, it is concluded that magnetic fields up to 20,000 gauss have no action on the Brownian movement. Ivan Peychès: Contribution to the study of some dry rectifiers. Pierre Urbain and Masao Wada: The detection of the alkali metals by the arc spectra method. The establishment of sensibility curves. The minimum quantities of the alkali metals which can be detected by the method described range between 0·000,002 mgm. for lithium to 0·008 mgm. for cæsium. Adolfe T. Williams: The structure of the spectra of hafnium and tungsten. Jean Lecompte and Jacques Perrichet: The rotatory dispersion in the ultra-violet of camphor in sulphuric acid solution. The existence of a substance in solution other than camphor or sulphuric acid is proved. V. Henri, Ch. Weizmann and Y. Hirshberg: The photochemical decomposition of glycocoll. The influence of the medium and of the wave-length. Charles Haenny: The thermal variation of the magnetic double refraction of paramagnetic solutions of salts of rare earths. The experimental facts prove the predominating importance of the paramagnetism term in the theoretical expression for this double refraction. Wenli Yeh: A new experimental proof of the layers of neutrons in the nuclei. Wolfgang Gentner: The disintegration of beryllium by γ-rays. Walter M. Elsasser: The constitution of the elementary particles and nuclear forces. André Léauté: The laboratory measurement of the roughness index of road coverings. E. Rinck: Solidification diagrams of the alloys formed by two alkali metals: sodium-cæsium alloys. Augustin Boutaric and Mme. Madeleine Roy: The physico-chemical transformations of gum arabic sols in the course of heating. Mlle. Paulette Berthier: The influence of the surface tension on the velocity of ascent of aqueous solutions through porous bodies. From the data given it appears that the surface tension has little or no effect on the velocity of ascent of aqueous solutions through porous substances. Pierre Pingault: The preparation of certain definite alloys. Methods for preparing the alloy $FeSn_2$. Lucien Leroux: The detection and rapid estimation of very low concentrations of active chlorine in water. Potassium bromide is added and the bromine thus liberated determined by the fuchsin method of Denigès and Chelle. The lower limit is 0·005 mgm. chlorine per litre. Albert Kirrmann: The allyl transposition. Studies by the Raman effect. The dichloride obtained by the interaction of phosphorus pentachloride with crotonaldehyde, regarded by Kekulé as a single substance, can be shown by Raman spectra to be a mixture of two isomers. M. Favorsky, M. Tchitchonkine and I. Iwanow: The molecular transpositions of the α bisecondary oxides of the fatty series and of normal structure. Georges Arragon: Methylation by the Fischer method of sorbose and its acetyl derivatives. Marcel Godchot, Max Mousseron and Roger Richaud: The resolution of some cyclanediols. Jacques Bondon and Louis Clariond: The geological itinerary of Aqqa à Tindouf (Moroccan Sahara). Josué Hoffet: The presence of the lower fossiliferous Permian in the western Haut-Laos. Paul Jaeger: New cases of gynodimorphism in the Dipsaceæ. Mlle. Berthe Biecheler. Proof of a mitochondrial network in some autotrophic Peridinians. J. Legendre: The maritime mosquito. Description of the habits of *Ædes punctatus*. This mosquito requires salt water for its development, and the succession and development of the generations of this insect are controlled, not by the rainfall, but by the height of the tides. Léon Binet and Daniel Bargeton: The action of the lung on aminoacids. The lung is capable of attacking an aminoacid, alanine, as shown by the production of ammonia, appearance of pyruvic acid and modification of the respiratory coefficient. Etienne Rabaud and Mlle. Marie Louise Verrier: The swim bladder, density and equilibrium plane of fishes. Paul Meunier: A new method for the determination of very small amounts of aluminium in complex media. Application to plants. The method is based on the precipitation with cupferron after removing interfering metals by a simple

process. JEAN COURTOIS: The influence of the reaction of the medium on the hydrolysis of the α- and β-glycerophosphoric acids by various phosphatases from seeds. RAOUL LECOCQ and MLLE. MARIE LOUISE BARBAN: Modification of the antirachitic activity of orthophosphoric acid by phenol esterification. ALBERT DEMOLON and ANTOINE DUNEZ: New observations on the 'sickness' of soils growing lucerne.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 6). N. KOSHLIAKOV: Some summation formulæ connected with the theory of numbers. E. BRUMBERG and S. VAVILOV: The accuracy of the photometric method of extinction. The method consists in the reduction of the intensity of light to be measured until it reaches the threshold of perception by an eye adapted to darkness. V. ARKADJEV: Pseudo-chemical action of the Hertzian waves and its application. V. GLAGOLEVA-ARKADJEVA: Separation of monochromatic rays in the white rays of a mass radiator. The method of a step-grid (*echelette*) proved to be eminently suitable for the purpose. I. KIKOIN: Effects observed by the illumination of cuprous oxide in a magnetic field. I. KURCHATOV, L. MYSOVSKIJ, B. KURCHATOV, G. SHCHEPKIN and A. WIEBE: Fermi effect in aluminium (2). A. VOROBJEV: Electrical resistance of rock salt irradiated with X-rays. The resistance in darkness remains the same, but that in light is reduced by about 30 per cent. A. MITKEVICH: An anomalous case of magnetic viscosity. On certain parts of the hysteresis loop, the changes of magnetic induction due to magnetic viscosity can have the opposite direction as compared with the changes of the induction that could be explained as eddy current lag. Therefore the phenomena of magnetic viscosity and eddy current lag are quite different in nature. V. ANTONOV-ROMANOVSKIJ: Natural extinction of phosphorescence in isolated zinc crystals. V. FABRIKANT and V. PULVER: Concentration of excited atoms in a mercury discharge at high pressure. H. HELLMANN: Combined approximate calculation of the problem of numerous electrons. V. FESENKOV: Determination of the polarisation of the solar corona. A method of three polarising mirrors is described as giving exact results. P. ZIMAKOV: Behaviour of some aqueous solutions in an electromagnetic field of high frequency. A. VINOGRADOV: Distribution of vanadium in organisms. An exceptionally high concentration of vanadium is to be found in Ascidians, and in some species of *Holothurians*. P. LAZAREV, Z. BULANOVA and L. COUPER: Fluctuations of the sensibility of the eye in peripheric vision. E. PRUZHANSKAJA: Symbiosis as a factor producing races in micro-organisms. When *Bacillus mycoides* was cultivated in the presence of *Bacterium pyocyaneum*, *B. prateus vulgaris* and *Sarcina ureæ*, four different races of the *B. mycoides* were obtained. N. ORLOVSKIJ: Importance of a biological study of varieties of beetroot in connexion with selection problems. V. CERLING and A. CHEPIKOVA: The results of varying the intensity of the factors of yarovisation. The biological properties of the plants have less effect on the intensity of growth than on its rate. The duration of the process of yarovisation is one of the primary factors responsible for the formation of reproductive organs, that is, for the yield. E. VLADIMIROVA: The content of amino-acids in the regenerating extremities of the axolotl, at different stages of regeneration.

Forthcoming Events

[*Meetings marked with an asterisk are open to the pu*

Sunday, December 30

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.—J. R. Norman: "Fishes".*

Monday, December 31

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Guy Dollman: "Great Game Animals of Africa"

Friday, January 4

ROYAL GEOGRAPHICAL SOCIETY, at 3.30. R. Kaulb "A Journey in Unknown Tibet".

CONFERENCE OF EDUCATIONAL ASSOCIATIONS, Dece 31–January 7. Annual conference to be held at versity College, Gower Street, London, W.C.1.
Marquess of Lothian: "Liberty and Collectiv (Presidential Address).

PHYSICAL SOCIETY, January 1–3. Annual exhibitio be held at the Imperial College, South Kensington, S.
January 1, at 8.—Dr. B. Wheeler Robinson: 'Architecture of Molecules".
January 2, at 8.—Dr. C. V. Drysdale: "The Pro of Ether Drift".
January 3, at 8.—Dr. H. Spencer Jones: "G Telescopes".*

SCIENCE MASTERS' ASSOCIATION, January 1–4. An meeting to be held at Oxford. N. V. Sidgwick: P dent.

GEOGRAPHICAL ASSOCIATION, January 2–5. An conference to be held at the London School of Econo Houghton Street, Aldwych, London, W.C.2.
Lord Meston: "Geography of an Indian Vill (Presidential Address).

Official Publications Received

GREAT BRITAIN AND IRELAND

The South-Eastern Naturalist and Antiquary: being the T ninth Volume of Transactions of the South-Eastern Union of Sci Societies, including the Proceedings at the Thirty-ninth A Congress, held at Reading, 1934. Pp. xlviii+128+5 plates. (Lo E. A. Martin, Hon. Sec., 14 High View Close, S.E. 19.) 5s. net

Air Ministry: Aeronautical Research Committee: Report Memoranda. No. 1609 (T. 3525): Wind Tunnel Tests on I Fighter Model with Slotted R.A.F. 34 Section Wings. By I Clark. Pp. 5+3 plates. 6d. net. No. 1617 (Strut. 199): St Determination in certain Cantilever Wings. By Dr. H. Roxbe J. Hanson and W. T. Sandford. Pp. 17+5 plates. 1s. net. No (T. 3028): Wind Tunnel Tests on a Model Gloster Troop Carrie W. G. A. Perring and C. Callen. Pp. 15+9 plates. 1s. net. No. (F.M. 101 and 101a): Arithmetical Solution of Equations Type $\nabla^4\psi$=Const. By Dr. A. Thom. Pp. 12+4 plates. 9d No. 1613 (T. 3474): Windscreens with Openings. By F. B. Bra and B. Lockspeiser. Pp. 7+6 plates. 9d. net. No. 1615 (T. Hot-Wire Type of Instrument for Recording Gusts. By L. Simmons and J. A. Beavan. Pp. 16+8 plates. 1s. net. (Lo H.M. Stationery Office.)

OTHER COUNTRIES

Chinese Materia Medica, 7: Dragon and Snake Drugs. By B E. Read. (Published by the Peking Natural History Bulletin.) 66+6 plates. (Peiping: The French Bookstore.) 1.50 dollars.

Department of Agriculture, Mauritius: Sugarcane Research St Bulletin No. 5: Studies on Root-Exudation and Root-Types in S cane. By Dr. H. Evans. Pp. 13+7 plates. (Port Louis: Gover Printer.)

Report of the Aeronautical Research Institute, Tôkyô Im University. No. 113: The Experimental Investigation on the E of a Cut-out on the Wing Characteristics. By Tetusi Okamoto 101–137. 35 sen. No 114: Effect of Shape of Discharge Val the Cut-off of Fuel Spray in Injection Systems with Open N By Fujio Nakanishi, Masaharu Itô and Kikuo Kitamura. Pp. 57. 20 sen. (Tôkyô: Koseikai Publishing Office.)

Annual Report of the Royal Alfred Observatory for the Year Pp. 7. Miscellaneous Publications, No. 15: The Cyclone S 1932–33 at Mauritius. By N. R. McCurdy. Pp. 4+42 charts. Louis: Government Printer.)

Report of the President of the Carnegie Institution of Washi for the Year ending October 31, 1933. Pp. 59. (Washington, Carnegie Institution.)